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A Special Pavement for a Special Use

Allotted for use for demonstrating farm machinery with wheels carrying spikes, lugs and cleats. Pavement containing ten percent more asphalt than is customary used seven years for this purpose, still in excellent condition

By P. L. Brockway*

THE PROBLEM

In the development of the city and contributing territory, a certain street in Wichita, Kansas, was gradually set apart for the use of wholesalers and jobbers dealing in farm tractors, self-propelled cultivators and plows, and other similar farm machinery. All of these machines, being made to operate in loose soil, have the driving wheels equipped with spikes, lugs, cleats or various combinations of these ground gripping devices.

The street surface was originally sandy loam along a river bank, having excellent sub-drainage. Very naturally, it became chopped into a dust heap in dry weather and a succession of mud holes in rainy periods, both conditions unsatisfactory in busy seasons as the volume of business increased.

TYPICAL VIEW OF TRAFFIC ROW, WHICH SERVES AS A PUBLIC SALES ROOM

THE FIRST SOLUTION

In 1913, at the request of the abutting owners the street was paved with an eight-inch sand-filled water-bound macadam base and a three-inch asphalt macadam surface constructed by the penetration method, using about two gallons of 90 to 100 penetration asphalt per square yard. This excess of bituminous binder was used in an effort to keep the surface re-annealed as the tractor lugs tore it up.

This pavement stood up fairly well for two or three years under terrific abuse. For example, one steam tractor weighing ten or twelve tons was so constructed that the front steering wheels could be turned squarely at right angles to the axis of the rear driving wheels. I have personally seen this machine shoving the front wheels in the attempt to make too short a turn. Tractors, at that time, not infrequently raised the front wheels off the ground as the rear wheels turned in a vain effort to move a "train" of heavy threshing machinery. Lighter machines were set for a short turn and permitted to run in the same small circular track for hours at a time at tractor shows and other exhibitions of farm or industrial equipment.

The marvelous thing about it was that the pavement simply became terrifically pitted and rough in the course of five years, with considerable tenacity and resilience left in the traffic-scarred surface and only occasional holes worn deeply into the sand-filled base. Such an uneven surface was very unsatisfactory to a jobbing center which included twenty-one distributing firms, thirteen of which reported sales amounting to seven and a half million dollars in 1926. No other street was available. A brick pavement on a connecting side street was com-

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pletely destroyed in two years under the impact of the heavy lugs.

THE LATEST SOLUTION

In 1921, the pavement was renewed by what might be termed plant-mixed macadam under the following specifications:

First, all loose material, of whatever nature or source, was removed with wire street brooms down to the remaining part of the old pavement which could not be dislodged by such methods. Nine years of rolling had compacted what was left of the original pavement to its ultimate density and position.

Second, the surviving portions of the asphalt-bound surface were torn up with a rooter and this material used to level up the old base.

A surprising amount remained so that the resultant surface after rolling was about one inch higher than the old original base. This particular step in the restoration of the pavement has been referred to as an example of black base. There was enough life left in the old surface that it did roll into a smooth, tough surface fully as effective as that obtained by the usual black base specification.

Third, the new wearing surface was prepared and applied in three successive steps along lines similar to the construction of penetration macadam but considerably modified in details of construction methods.

A. Crushed stone passing a 2½-inch circular mesh screen and retained on a one-inch screen was heated to about 250 degrees in an ordinary revolving drum kiln in a standard asphalt mixing plant. The stone used came from igneous waste at zinc and lead mines in the Joplin, Missouri, district. It is very tough, the French coefficient averages about 10, the fracture is clean and the edges sharp, the surfaces are glassy and non-absorbent. This heated stone was mixed in an ordinary asphalt pug mixer with sufficient asphalt, of 90 to 100 penetration, to coat all the surfaces. More than half the mixer teeth were removed before introducing the stone. Many more were broken by the wedging of the very hard, tough material.

The asphalt-coated stone was spread on the prepared base while hot, as thin as possible to make a continuous sheet, and rolled to uniform contour with a five-ton roller. The actual thickness was nearly three inches, and asphalt requirement about four pounds per square yard.

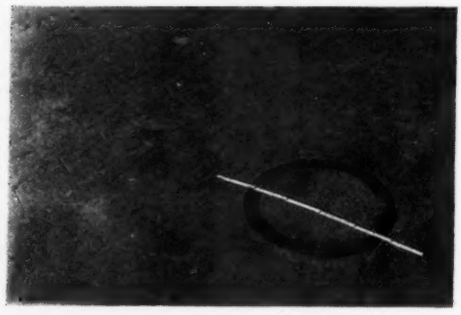
B. Limestone passing a one-inch screen, with none of the fines or dust removed, was heated and mixed in the pug mixer with "sufficient asphalt to make a plastic mixture." This was spread and rolled into the coarser material while hot, in sufficient quantities to produce a smooth surface "free from pits or open places."

This stone was produced by crushing the waste material in a quarry furnishing building stone as its major product. The stone is almost pure calcium carbonate, crystalline, clean and ranking high among limestones in hardness, toughness and low absorption. Screen analysis showed remakably uniform grading from about five per cent passing a 200-mesh screen up to the maximum size. This per square yard, instructions being to use enough course required about nineteen pounds of asphalt A. C. to make a street mixture of normal consistency and then add about ten per cent more. The resultant surface was very similar to that obtained by coarse aggregate asphaltic concrete specifications.

C. A squeegee coat of hot asphalt was placed on the rolled surface, on which was spread hot sand followed by thorough rolling with an eight-ton roller. Additional hot sand was added as long as the asphalt bled through to the top.

About six pounds of asphalt per square yard was required in this final treatment, making a total of twenty-nine pounds or more than three and one-half gallons per yard in the total wearing surface having a thickness of about three and one-half to four inches. This is nearly twice as much as is used in ordinary penetration macadam.

Wind and rain soon removed all of the sand not actually imbedded in the pavement before the tractor traffic had kneaded much of it in. Bleeding in many places made it necessary to spread additional sand the first summer. Ninety-five penetration asphalt is fairly sticky at pavement temperatures of one hundred or above. One tractor wheel of the type shown in the picture rammed its lugs entirely through the surface in a soft spot and lifted a patch out as it advanced. Only one incident of this extreme character occurred so far as I know. Sand and dust absorbed excess asphalt during the first season. The picture showing typical machines of that time was taken when the pavement was two or three years old. The appearance of the surface as to smoothness of texture and contour is clearly shown. There is no change in either of these conditions today. Seven years of service under traffic incident to selling and delivering at least ten million dollars of machinery per year has resulted only in final compression. Present texture and smoothness is shown in the picture at a manhole which also indicates the amount of settlement due to compression. There has been no loss of pavement in any measurable amount, the surface yielding to the tamping, kneading action of the lugs rather than offering an abrasive resistance.



SURFACE TEXTURE OF SIX-YEAR-OLD PAVEMENT

Compression of about one inch below manhole head. Marks by tractor wheels show at left of same.

ANOTHER TYPE OF PAVEMENT

It is pertinent to add to the description of the above special design that a short length of connecting pavement, carrying an appreciable amount of tractor traffic in addition to ordinary street traffic, has been given a different treatment.

It was paved in 1913 with three-inch penetration

macadam on an eight-inch sand-fill macadam base. Completion of a bridge and paving of other portions of the street diverted so much general traffic over it that the rough worn macadam was resurfaced in 1923. After cleaning the surface, low spots were levelled up with asphaltic binder or black base, and a wearing surface two inches thick was placed over it. This surface is modified sheet asphalt of the following average composition:

A. C. 8.0 to 8.5 average 8.2 per cent.
Passing 2 mesh 10 to 20 average 12 per cent.
Passing 4 mesh 10 to 20 average 12 per cent.
Passing 10 mesh 15 to 25 average 17 per cent.
Passing 40 mesh 25 to 35 average 28 per cent.
Passing 80 mesh 10 to 20 average 14 per cent.
Passing 200 mesh 8 to 11 average 9 per cent.
Asphalt penetration was 40 to 50.

This makes a very hard, dense, tough surface with the materials which are locally available.

Tractor lugs mark it very badly in hot weather during the rush periods of delivery. So far, it has ironed out smooth under general traffic and has remained in entirely satisfactory condition. There is some loss of material. The lugs on revolving wheels sometimes leave raw edges in the dents in the pavement which are worn off and carried away in the kneading process.

Street Traffic Engineer in San Francisco

In the fall of 1927 San Francisco created a division of street traffic engineering under the jurisdiction of the Board of Public Works and forming a part of the Bureau of Engineering of the Department of Public Works. The ordinance creating this division provided that "The division shall consist of a competent traffic engineer who shall be known as the city traffic engineer, to be appointed by the said Board of Public Works, pursuant to law. It shall be the duty of the city traffic engineer to conduct studies of street traffic accidents and congestion and of other conditions affecting the safe and convenient use of the streets; to collect facts regarding the effect and operation of regulations controlling street traffic and to plan with and otherwise assist the Police Department and Board of Supervisors in the placing, maintenance and operation of traffic signs, signals and markers."

G. D. Burr, of the Department of Public Works, was appointed city traffic engineer, and on the basis of studies made of traffic conditions, remedies were proposed and his recommendations have in every case been approved by ordinance. The system of arterial streets has been modified, loading zones and no-stop zones have been located and improvements have been made on mechanical traffic aids. This division was called upon also to recommend the streets which should be given preference in the annual street reconstruction program.

The report for the year 1928 states that during the year a contract for installing 60,000 pedestrian lane markers was let for the estimated amount of $4,352, and specifications were being prepared for wiring 500 existing arterial stop signs which hitherto had not been illuminated, at an estimated cost of $60,000.

Airport Development in the United States

Factors involved in selection of site and design of airport. Area, accessibility to city, topography, flying conditions, parking facilities, runways, hangars and other buildings.

By Gordon E. Crosby*

The rapid development in aeronautics since the war and the added stimulated growth resulting from the recent trans-Atlantic and trans-Continental flights is convincing proof that the present generation has overcome the ingrained habits of thought of land and sea travel and are being educated to the economic and practical value of air travel.

That the conquest of the air is rapidly becoming a reality is substantiated by the following facts: There are already many more airplanes in the hands of miscellaneous users than are owned by the transport companies flying scheduled routes. At the end of 1927, the airway operators had in service but 128 airplanes while the total number of civil airplanes in this country was 3731. In the same year the scheduled flying on established airways amounted to 5,809,999 miles while the miscellaneous flying amounted to 30,000,000 miles. At the end of 1928, there were 200 airplanes in service by airway operators and over 7800 civil airplanes in use and the mileage flown was proportionately greater than in 1927. In 1927 there were 1,449,364 pounds of mail carried over internal lines, contract and post office, while in 1928, up to November 1, 9,000,000 pounds were carried. At the present time there are 7828 airplanes, licensed or pending, and it is estimated that 10,000 planes will be manufactured this year by 39 modern factories, together with some 5000 by other smaller concerns.

In fact, we can anticipate the moment, without hesitation, when all of the first class mail of the country, amounting to more than 476 tons daily, will be carried by airplane for distances greater than three hundred to five hundred miles. This would mean that where one or two daily scheduled flights now carry mail between our larger cities, there will eventually be hourly service of planes from one destination to another which will be fed or supplied by tributary lines from the smaller communities.

Although much prominence has been given to accidents in aviation, statistics show that the percentage of casualties is much smaller than in other modes of travel and the majority of these accidents have been caused by stunt flyers or unskilled pilots. Accidents will diminish with more strict regulation and

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licensing, increased reliability in engines and planes, and the proper development of the airports and control which, no doubt, will create confidence and greater interest among the public.

In Europe the various governments allow subsidies to the operating companies and aid has been given for the development of the airports, airways and transportation companies. Our Federal Government, however, has adopted a definite policy wherein they will develop the airways but the commercial airports must be developed by private individuals, corporations or municipalities. This task has been well fulfilled to the extent that in the period of a very few years there have been developed more than 425 municipal, 415 private, 304 intermediate, 340 marked auxiliary airports, and 942 have been proposed. However, with the anticipated growth in transportation it is safe to assume that it will be necessary for every community to develop a safe airport which will be adequate to accommodate its allotted quota of traffic.

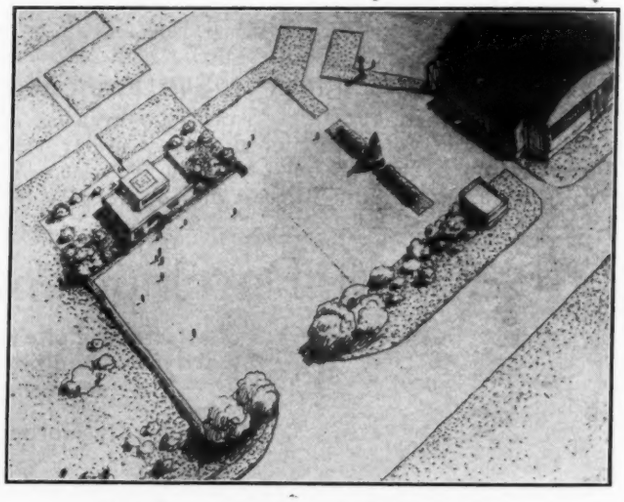
During the world war it was necessary to select sites large enough to permit landing and take-off of planes without too great a risk. These training fields were developed simply to house a large number of planes and personnel without considering commercial aviation. Later, pilots took ships throughout the country and started "barn-storming" on plots of ground which would permit of flying. Our present day conception of an airport is something entirely remote and different from these landing fields. It is necessary to design and provide for regular scheduled commercial transportation. This is not a simple problem and demands engineering knowledge equally as important as for railroad terminals or steamship docks.

The Department of Commerce has issued a bulletin which enumerates the many requirements of an airport in order to receive a certain rating. These are basic requirements which are wholly or in part accepted, but the locations, proper coordination, arrangement and facilities are different in every case and need special study.

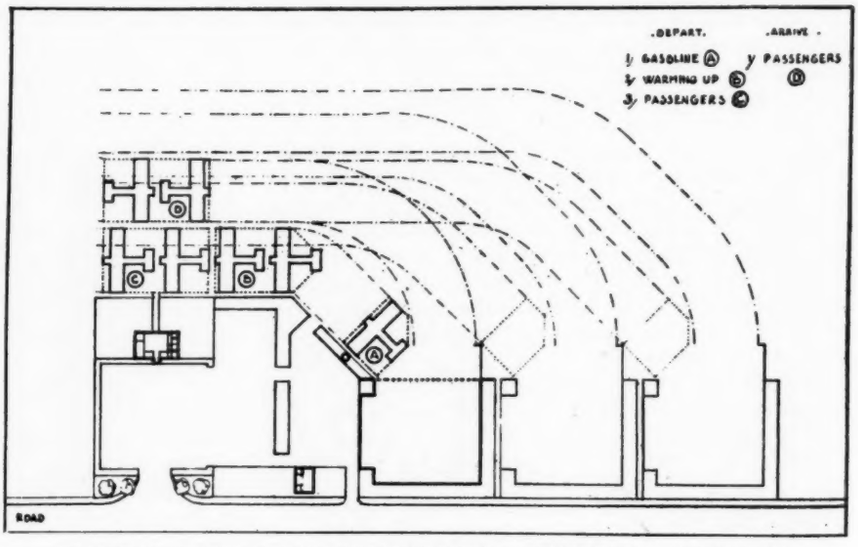
The selection of a site for development involves many diversified factors and should be done by experts who are familiar with aeronautical conditions and requirements. A reconnaissance and aerial survey should be made of the community and surrounding territory, and all possible sites listed and located. These sites can then be balanced one against the other in regard to area, topography, approaches, flying conditions, accessibility, possibilities for expansions and cost of development. The area necessary varies from forty or fifty acres to a section of land and possibly even a thousand acres, depending on the shape of the property, orientation with respect to the prevailing and storm winds and the use to which the airport is to be subjected. It is necessary to obtain length of runway in all directions so that planes will not experience any difficulty in take-off or landing. It is thus obvious that the main terminals in this great chain of transportation must accommodate both larger planes more heavily laden for passengers, express, freight or mail service and also faster planes for long trans-continental flights. The average length of take-off required at the present time, under ordinary conditions, is from one thousand to two thousand feet, but newer types of planes might require runways up to four or five thousand feet in length. It is necessary therefore to allow for expansions in accordance with these advanced designs.

The topography of the site should be nearly level, although slight rolling is not objectionable and might assist in the natural drainage. The surface should be firm, smooth and well drained so as to eliminate hazards in landing and take-off, and should be made available for operations at all seasons of the year.

General flying conditions is the next important factor involved after selecting an area which is of sufficient size. The surrounding terrain should be considered in regard to the suitability for emergency



AIR VIEW OF TRAFFIC CIRCULATION ARRANGEMENT



TRAFFIC CIRCULATION ARRANGEMENT, SERVICING, DEPARTURE AND ARRIVAL AREA

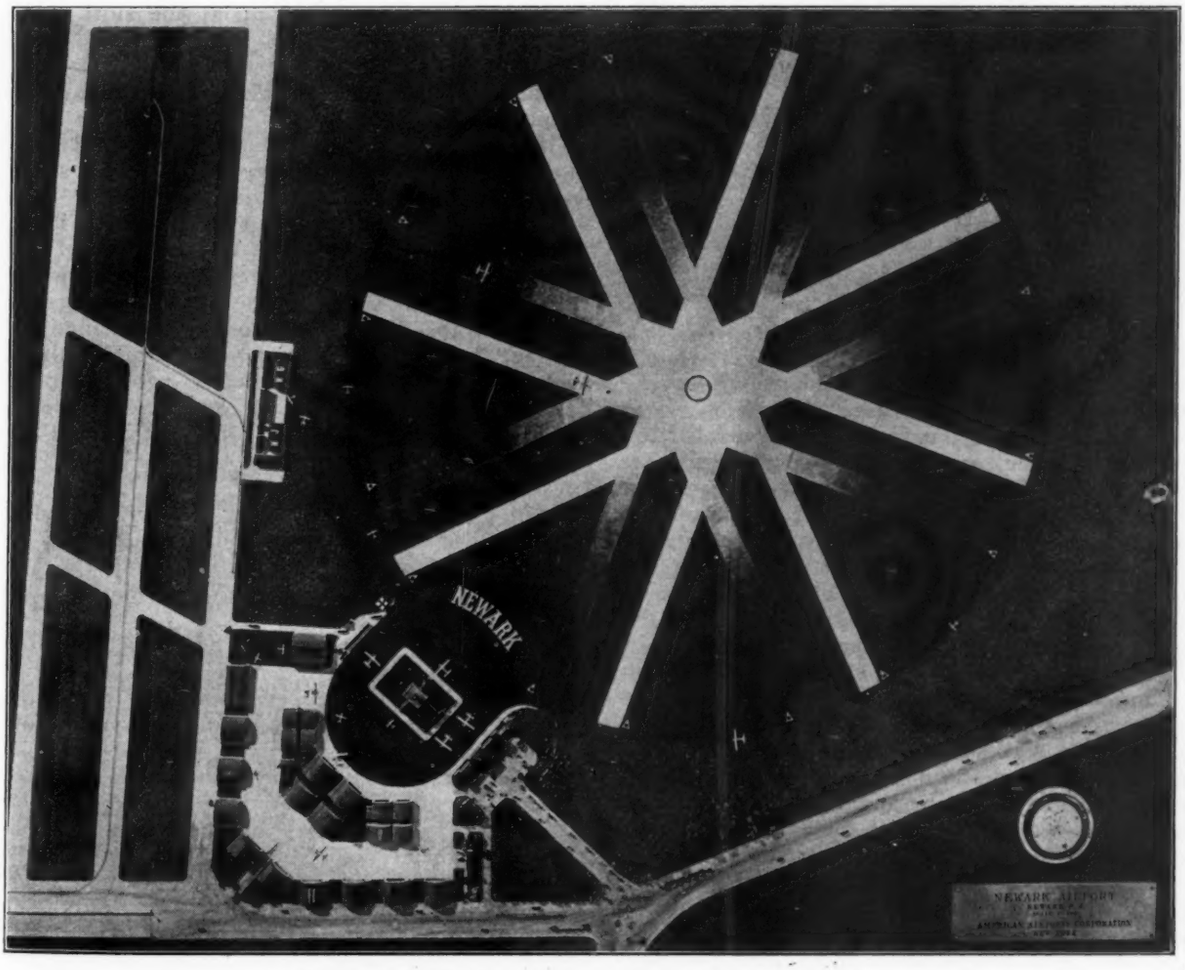
landings or its effect on air currents. The approaches should be well defined and clear of hazardous obstructions. The frequency of fog and mist should be taken into consideration as well as the location with respect to the thickly populated or factory sections of the community so that the prevailing winds will tend to blow the smoke away from the site. The location of the site with respect to the community and the main travelled airways should be such that planes will not be forced to fly over the thickly populated sections. All of these points have a direct bearing upon the amount of outside traffic which can be induced to use an airport.

This development of air travel is a decided step in speeding up transportation from one point to another. So the gain effected by the airplane should not be wasted in transferring mail, express and passengers between the airport and the commercial and industrial sections which are served. There is no advantage if one saves two hours by air travel if this time is dissipated at each terminal in the journey from the city to the airport and return. This means that accessibility becomes of great consequence and is a decided factor in the final site selection.

All of these preceding facts have a direct bearing on the selection of the proper site to be developed and should be proportionately weighed one against the other.

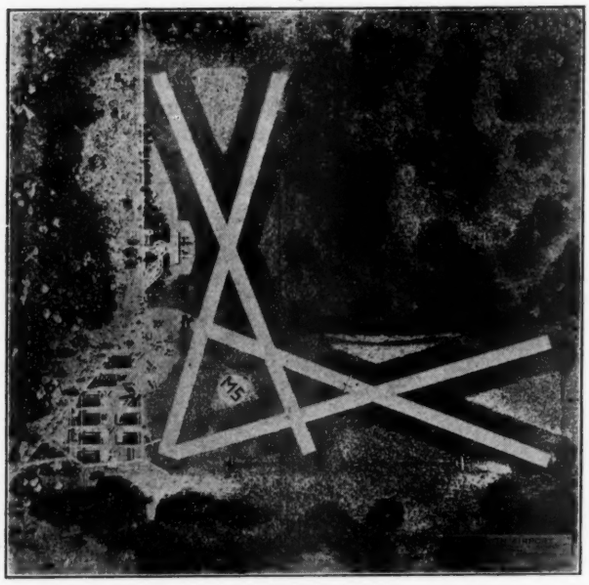
The next step is the design of the airport. The runways, hangars, buildings, control office, administration building, parking facilities and concessions should be arranged so that a maximum volume of traffic can be accommodated under proper jurisdiction and control. The runways should be oriented with the prevailing winds to give maximum length of take-off. These runways have to be well drained in order to allow for quick dissipation of surface water from heavy rains. It is essential that transportation schedules be closely adhered to without a possible interruption on account of "muddy fields." The surface should be smooth and fairly level without any sharp ridges or depressions and so constructed as to be unyielding. It has been found that planes strike the ground, upon landing, with an impact equal to between two and seven times their weight. With the weight of the present planes amounting to ten or twelve tons and anticipated designs running into twenty and thirty tons, special attention will certainly be required in the construction of runway surfaces. These surfaces have been formed from well fertilized turf grown from special seed formulae, well compacted cinders with an application of road oil, macadam or concrete; the kind of treatment should be specified according to varying conditions.

The hangars must be located so as to be readily accessible and with the elimination of long initial ground taxi. There is a psychological effect that



DESIGN FOR NEWARK AIRPORT, NEWARK, N. J.

a passenger getting into a plane is anxious to fly and should not be subjected to the suspense of a long ground taxi before arriving at the point of take-off. This effect is not so marked after a passenger has completed a flight and the plane has to taxi up to the point of disembarking. The other buildings should be so arranged as to give a natural flow to the passengers from the stage of arriving at the airport, through the passenger depot, waiting room and ticket office and out to the plane. The complete design should coordinate so as to provide for natural circulation of traffic and elimination of congestion and possible points of collision, so that all operations can be properly controlled and managed as fully as in our large railroad terminals. All should be treated with a pleasing architectural effect and accommodations made for the comfort and safety of the passengers in order to attract the



DESIGN FOR "MID SOUTH" AIRPORT, SOUTH CAROLINA

public and instill a feeling of security. Parking spaces, concessions, restaurants, club houses and beautification of the grounds should be provided for the general public, in order to induce attendance. These people will be potential passengers as soon as they become "air-minded" or are in need of this rapid mode of transportation.

All of these facilities are beneficial to the airport as they are real and practical sources of income which are essential if it is expected to operate the airport on more than a self-sustaining basis.

Careful estimates of cost should be prepared from well executed plans so that proper and sufficient funds can be provided to finance the development and assure a successful conclusion. It is not essential to construct the ultimate design at first but the development should be carried on in stages. The preliminary layout should accommodate the present requirements and proper improvements be made as traffic demands, until the ultimate capacity of the airport is completed. With a well formulated design and a proper program of expansion, this development can be accomplished without costly changes or discarding work already completed.

How Operating Conditions Affect Imhoff Effluent

By E. W. Steel* and P. J. A. Zeller

The Sewage Research Laboratory of the Texas Engineering Experiment Station located at the Agricultural & Mechanical College of Texas, coincidently with other studies of sewage treatment, has obtained some figures indicating the importance of the use of proper operating methods to obtain the best results in Imhoff tank operation. The fact that Imhoff tanks will continue to give some sort of service, even when badly operated, frequently results in considerable neglect unless very serious difficulties arise, as foaming or severe odor troubles. The effect of everyday operation must affect materially the secondary processes of sewage treatment and also the final effluent.

The Imhoff tank referred to in this article has a maximum capacity of 300,000 gallons per day, although it is operating at a considerably lower rate at the present time. The gas vent area is approximately 30% of the total tank area. The horizontal overlap at the slots is 12 inches. The total depth of the tank is 25 feet. No foaming has ever occurred at this tank during the period that it has been observed by the writers.

The raw sewage is very concentrated. It contains a high percentage of grease, and scum blankets accumulate very quickly in the flow chambers and gas vents of the Imhoff tank. Sewer grades are rather flat and, in spite of the comparatively short path of flow, the sewage arriving at the plant has the characteristics of stale sewage. This condition is intensified by the fact that the water supply has a high sulfate content which results in heavy production of hydrogen sulfide. These factors all combine to lower the efficiency of an Imhoff tank. They can, of course, be overcome to some extent by very careful operation.

Just prior to the starting of experimental work at the College sewage disposal plants, an excellent opportunity presented itself for the study of the effects of operating methods on Imhoff tank effluent.

A change in the operating personnel resulted in an intermediate period during which the Imhoff tank did not receive normal attention. There was a heavy accumulation of greasy scum in the flow chambers and the sides of the flow chambers held considerable amounts of adsorbed material, which, together with the scum, was highly septic. Particles of the scum and adsorbed material could be observed leaving the tank in the effluent. The gas vents had plugs of scum in them to a depth of five to six feet. Belching of gas and partially digested solids into

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the flow chamber and apparently from the digestion chamber were of frequent occurrence. This happened even though the sludge level in the digestion chambers was well below the slots. The rising solids included both raw and partially digested material.

The conditions mentioned above are frequently seen at municipal sewage treatment plants. It is known that they affect considerably the quality of the tank effluent. It was believed that quantitative determinations of the effect of poor operation would gve designing engineers valuable data as to the extra burden which will be placed thereby upon secondary treatment processes. The bio-chemical oxygen demand was chosen as the best indicator of the quality of the effluent.

Accordingly, the tank was allowed to operate with scum blankets and side wall accumulations undisturbed for three weeks until a series of samples had been taken. Thereafter the scum accumulations in the gas vents were removed and the later accumulations were kept broken up. Scum in the flow chambers was removed daily. The vertical and sloping sides of the flow chamber were squeegeed daily and the slots were kept clear and unobstructed by means of a short length of heavy chain attached to a pole.

There was a marked improvement immediately apparent in the appearance of the effluent. Rising of gas and solids in the flow chamber became infrequent and the production of scum in the flow chambers was noticeably less.

Whether the lessening of the belching effect is to be attributed to cleaning the slots or to removal of the deep plug of scum in the gas vents is uncertain. Since the rising mass of solids included both raw and partially digested material, it is possible that the mass hung in the slots until it became impregnated with sufficient gas to cause it to rise. Or it may have entered the flow chamber as the result of disturbances in the digestion chamber. The improvements in operation were started simultaneously and accordingly there was no opportunity to note the effects of any one process.

During the period of observation there was no great change in the character of the raw sewage. Its average bio-chemical oxygen demand was well over 300 p.p.m., rising in some samples to 750 p.p.m. when the sewage contained a large proportion of laundry waste. The average biochemical oxygen demand of fifteen samples of the Imhoff tank effluent taken, before the improvements were made, was 355 p.p.m. The demand of the effluent after improvements, as shown by the average of seventeen samples, was 239 p.p.m. In other words, good operation reduced the bio-chemical oxygen demand of the Imhoff tank effluent by 116 p.p.m.; an improvement of 30%.

The slot cleaning, squeegeeing, removal of scum from the flow chambers (by hand skimming), and the breaking of sludge in the gas vent required the time of one man one hour daily at the tank.

Industries and Public Water Supplies

Health hazard and effect on filtration plants caused by industrial wastes in rivers

By Wellington Donaldson†

In spite of the abundance of literature on the subject of the pollution of water by industries, the multitude of investigations relating to it and the litigations involved thereby, it is surprising that some important phases of the subject are continually being overlooked, not only by industrial contributors to the pollution, but by water works people as well. Also it is somewhat remarkable that the heaviest pressure for the elimination of stream pollution nowadays comes chiefly from those interested in preserving the attractiveness of water courses, restoring fish life, and the expansion of recreational facilities, rather than in the preservation of streams as suitable sources of public water supplies.

Since 1920 a standing committee of the American Water Works Association has been considering the subject. As a result of its preliminary survey it reported, in 1922, about 250 public water supplies adversely affected by various trade wastes, which represented only a small per cent of the approximately 8,000 water supplies existing in the United States at that time, and only the outstanding or aggravated examples known to the committee through published experience or personal contact. Of course, practically every water supply drawn from streams which drain well populated areas may be affected in some degree by trade waste, but fortunately in the majority of cases such pollution is inappreciable.

The author classified water works experiences with trade waste under the following heads: First—The wastes cause nuisance and complaints, but the water works is lacking in the purification facilities considered proper to the protection of its consumers. Second—The wastes give rise to obvious nuisance and complaints from water consumers on account of taste, odor, or appearance in spite of well designed and carefully operated purification facilities. Third—The wastes, on account of nature, quantity, or irregular discharge, are likely to upset the operation of water purification processes, and therefore constitute a potential or actual hazard to the health or life of water consumers. Fourth—The wastes may be satisfactorily purified without undue hazard to the hygienic or physical qualities of the water supply but their presence imposes a financial burden on water consumer or taxpayer.

Of the first it need only be said that the municipality is in a weak position for complaining about the acts or others when it does not itself take any precautionary measures.

*Abstract of a paper before the Tennessee-Kentucky Section of the American Water Work Association.

†With Fuller & McClintock, Engineers, New York City.

The second group refers especially to cases where the discharge of phenolic substances, of salt water from oil well operations, and of various putrescible substances from canneries, etc., results in objectionable tastes, odors or appearance. These conditions are quite generally understood and have received considerable discussion and have been the subject of many court decisions.

Regarding the third group, where hazard to health is involved, water plant operators are usually well informed but its importance has not been sufficiently stressed and therefore is not appreciated by industries responsible for the conditions. In some comprehensive stream investigations completed or now in progress, undue emphasis is given to the items of dissolved oxygen, biochemical oxygen demand, and biological surveys, but these may have little or no bearing on the difficulties of water treatment plants obliged to purify the water.

Purification consists of a limited number steps, namely (a) plain sedimentation; (b) clarification with chemicals; (c) filtration; and (d) sterilization. Sedimentation is not a critical process and does not even form an invariable part of water purification plants.

Coagulation is universally practiced in connection with rapid sand filters and in some cases in connection with slow sand filters. It is not yet under perfect laboratory control and sometimes is accomplished with difficulty with natural waters unpolluted with trade wastes. However, it is undeniable that in many cases trade wastes interfere markedly with coagulation, either on account of inorganic substances which exert a harmful buffer effect, or the addition of organic substances which act as protective colloids against cogulation. The action is more troublesome in the case of intermittent dumping of the harmful substances and during periods of low stream flow when the concentrations are more pronounced.

Failure of coagulation at water plants generally means deterioration in the physical quality of the treated water, lowered bacterial efficiency in both basins and filters, and possibly loss of sterilization. With a heavily polluted source of supply the effect may be quite serious to the public health.

Filter efficiency is impaired if the water is not properly coagulated beforehand, in the case of rapid sand filters; and filter beds may become clogged with foreign matter to the point where they do not function properly.

In regard to sterilization, where the supply is relatively free from sewage pollution, chlorine (which is practically a synonymous term with sterilization in water works practice) may be regarded as an additional safeguard; but in the case of supplies subjected to heavy bacterial loading, chlorine becomes a vital link in the chain of purification processes, and any interruption may have serious consequences to the community served. Chlorine readily combines with inorganic reducing agents, such as ferrous sulphate, sulphur dioxide, sulphides, sulphites, hyposulphites, etc., and with many kinds of organic matter, and it is readily apparent that intermittent dumping of wastes of this character into the source of supply may nullify without warning the sterilizing power of the chlorine applied and thus create a serious hazard to the water consumer.

The third situation is an economic one. It is assumed that the wastes discharged into the stream increase the cost of furnishing satisfactory water although, because of adequate treatment, they do not cause complaints from the consumers or impose undue hazards to the hygienic quality of the water. A few illustrations of the effects in mind are given. The addition of caustic lime causes first an increase in hardness, followed by a decrease as softening takes place, and in extreme cases may be followed by another increase in hardness. Soluble salts of calcium and magnesium increase the hardness in direct proportion to the amount added. Slight increments of hardness may not be appreciable because the natural stream is continually undergoing variation in this constituent, yet each increment affects indirectly the pocketbook of every consumer of water. Assuming that each part per million of hardness requires 0.1 pound of soap per thousand gallons of water, and that one gallon per capita of water per day is softened with soap, for a population of 100,000 people this means ten pounds additional soap for each one part per million increase of hardness, or $730 per annum increased outlay for soap, to say nothing of the attendant effects on steam boiler plants, hot water heating devices, etc. An increase of 10 parts or 100 parts in hardness would cause considerable additional expense.

Considering the matter of operating chemicals, it is no uncommon thing for industrial wastes to increase the required coagulant dose of alum by as much as a grain per gallon. For a community of 100,000, this means about 1,430 pounds of alum per day, or a yearly increase of about $7,300 in the operating expenses of the department. Similarly, an increase in the chlorine dosage, the necessity of using lime or soda to assist coagulation and to combat corrosion, labor required for overhauling filters, etc., are inevitably accompanied by an added expense to the taxpayer, the water consumer or the stockholder.

To what extent is a water department justified in submitting to these or similar increases in operating expenses before complaining and seeking a remedy?

The author of the paper does not attempt to give an answer to this question. However, he calls attention to the fact that in Pennsylvania, Ohio, North Carolina and Wisconsin agreements are made between the state boards of health and certain industrial groups providing for a co-operative study of the problem and abatement of unnecessary pollution, and states that it is the general experience both in this country and elsewhere that the most good can be accomplished by such co-operation. While statutes exist in most of the states forbidding stream pollution, there is hesitancy in enforcing them where this would threaten extensive in-

dustries and through them possibly the prosperity of the state as a whole. While many states, and especially some of the newer ones, are inviting capital to establish new industries, they should have adequate assurance that, in developing some of the state's resources, the water resources will not suffer materially. In many cases it is not unreasonable to expect industries to install, in connection with new processes, recovery or treatment methods for preventing stream pollution, where such methods have been demonstrated to be feasible.

Development of Flood Control Along the Mississippi

By Herbert T. Slade*

In this article and others to follow, Mr. Slade will discuss problems of levee construction as they affect both the contractor and the equipment manufacturer. This first article is of the nature of an introduction, outlining the development of levee construction from the individual and community beginnings prior to 1880, *up to the* 1927 *flood.*

There was a time when the Mississippi was simply a big, muddy old "Father of Waters" rolling down through the tangled growths of the lowlands and unknown swamps to the Gulf of Mexico. Little was known about the river except that it provided a good means of transportation by packet boat from New Orleans to St. Louis. Although there extended from Cape Girardeau, Mo., to the mouth of the river a wide and fertile valley, unexcelled in productivity and richness of soil, this area was little known and sparsely settled. Malaria and other diseases were prevalent among the few residents.

In time it was learned that in the delta region there was probably the greatest stand of timber to be found anywhere in the country. Willows and cottonwoods grew on the islands and immediate banks of the river; oak of the finest quality was found on the higher grounds; the swamps were filled with cypress, gum and other valuable woods. In the process of cutting and marketing this timber, the delta region gradually became more settled, and small patches of land were brought under cultivation.

Owing to the annual overflows of the river, much of this land would produce a crop only once in four or five years. To prevent this flooding of the cultivated land, an individual property owner, with his team and a rude (perhaps home-made) scraper, or a group of owners with shovels and wheelbarrows, would construct small protection ridges or levees across the low places, which would protect them from the ordinary minor rises in the river.

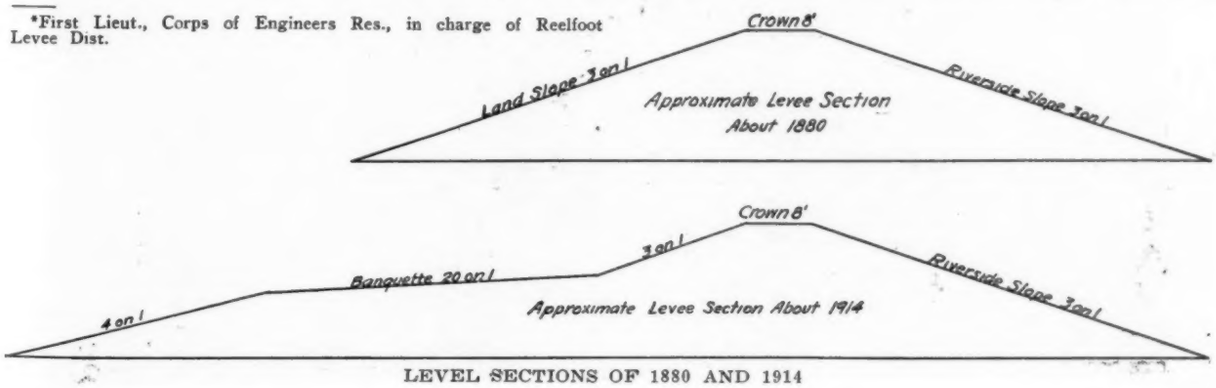
Then came further organization by counties, parishes and levee districts. The method of construction was still crude. Timber was cleared along the line chosen for the levee, and a ridge of dirt three to ten feet high was built up without regard to foundation, preparation, slope, height or section, and without reference to any particular grade line.

The construction of these levees was slow and difficult. The principal equipment consisted of drag or wheel scrapers. A team would haul, in a good day, from 15 to 20 cubic yards. The excavation of embankment material was usually kept a safe distance from the toe of the embankment or levee, but little attention was paid to other details now considered essential.

These little individual or community systems of protection grew until they became recognized as indispensable to the farmers. As more lands were reclaimed from the river, the annual height of flood waters increased due to the increased restriction of the flood channel, and the levees had to be made higher. With the increased height, costs increased and Congress was appealed to for aid.

In 1879 the Mississippi River Commission was created for the purpose of developing and carrying out a comprehensive plan for channel improvement and flood control. Surveys were begun under the direction of the Chief of Engineers of the Army, through the Mississippi River Commission, and the result of these surveys formed the basis of design of a levee grade and section. Subject to further surveys and investigations, a levee section was chosen with a crown width of 8 feet and side slopes of three on one. The cooperative plan of work provided that counties or local levee boards were to provide rights-of-way and pay one-third the cost of construction. With an appropriation of from three to six million dollars a year to be divided among levee work, revetment or bank protection,

*First Lieut., Corps of Engineers Res., in charge of Reelfoot Levee Dist.



LEVEL SECTIONS OF 1880 AND 1914

LEVEE CONSTRUCTION WITH OLD MULE-DRAWN WHEEL SCRAPER

and channel improvement, work along the Mississippi became an organized function of the government.

EARLY CONSTRUCTION METHODS

Construction methods were now placed on a firmer basis. In preparation for levee construction, all trees, stumps, trash, and other organic materials were removed from the area to be occupied by the levee, the ground was plowed so as to cause the embankment to bond with it, and a "muck" ditch was dug along the center line of the levee to a depth of three or four feet in search of logs, stumps or unfavorable soil conditions.

The levee was built up in regular 3-foot lifts of clean earth. A berm was left, extending forty feet from the toe of the embankment to the borrow pit, where there was a 3-foot drop on a one-to-one slope to the borrow pit, beyond which point the slope was held to one on fifty.

New equipment began to appear. In addition to the drag and wheel scrapers were the three-mule and four-mule dump wagons which could carry about 1⅓ yards at a load. These were loaded by elevating graders of very crude construction. An old-type road plow was used to loosen the earth and place it on the conveyor. This was constructed with a heel bolt, which was designed to break when the machine hit a root or stump of any considerable size; and often there was almost a continuous performance of replacing heel bolts—the original of the "get out and get under." The elevating graders were pulled by six to ten teams, and later by the old-fashioned, high-wheel tractors which, a good part of the time, required three or four teams to aid them. As a rule these tractors operated fairly well on level ground if it was not too wet, but it took lots of space and a good deal of time to turn around. The engines heated up and frequent stops for cooling or changing water were necessary.

OLD HEEL-BOLT TYPE ELEVATING GRADER

Stumps were always dug out by hand, and there was considerable drainage ditch work to be done by the same method. A contract of 60,000 to 100,000 cubic yards was quite an undertaking for a man with not more than two units, and usually required the full season from July to January.

These were the days of the "honky-tonk," which each contractor had to provide. This consisted of a big tent equipped with an old, and generally cast-

OLD HIGH-WHEEL TYPE TRACTOR ASSISTED WITH THREE TEAMS OF MULES

off, piano, and a couple of long tables. Here the darkies found recreation after the long hours, which lasted from "can" to "can't"; in other words, from the time when it is light enough that one "can see" the shadow of a man on the outside, until it is so dark that one "can't see" to work longer.

In those days the camp blacksmith was one of the most important men on the job. He was kept busy straightening rods, repairing broken parts, and making four-up eveners for the mule teams. He had to be able to repair anything on the job, keep the wagons in working condition, and repair and make new truck bodies and dumping chains.

THE EXPERIMENTAL PERIOD

It soon was realized that ways would have to be found to place more dirt in a shorter time and at less expense. Contractors began using small tractors, such as farm tractors, to pull dump wagons; but this was not generally a success, the chief drawback seeming to be the lack of some means of loading the dirt into the wagons more rapidly. Then Holt and Best tractors of the 30 and 60 horsepower type were tried for drawing the old elevating graders, and began walking away with them. This, in turn, brought on new questions, such as heel bolt breakage and carrier wheel slippage. The latter was finally overcome, and the substitution of the disc plow for the old road-type plow eliminated the need for backing up when striking roots and stumps and delaying the work to replace heel bolts. Also the fine sand proved too much for the crawler treads of the tractors, grinding them out rapidly; but this difficulty, too, was overcome and the modern crawler tractor tread developed.

IMPROVEMENT OF THE LEVEE SECTION

By this time the Mississippi delta region had developed wonderfully. The greater portion of the timber was gone and large sections of the country were in a high state of cultivation; roads were being built, drainage systems had been worked out, and these and other improvements, as well as modern medical science, had eliminated much of the malaria and typhoid fever, and deep wells were bored to provide pure water.

All this increased the necessity for flood protection over a rapidly expanding area. It was recognized that the levee sections previously built were too small to withstand the continually rising flood levels, and the levee section shown on page 97 was adopted. This provided for a banquette section to further strengthen the levees against prolonged high water stages. But due to lack of funds, and to the greater necessity of reinforcing levees which were even lower and weaker than the original standard, the new section was not immediately built on a large scale. Added to the other problems was that of providing loops and setbacks for those places where the river was encroaching on the land through bank erosion.

While bank protection has always been considered a major project, only rather recently has it been appreciated that levees can not fulfill their allotted task without bank stabilization. Bank protection is costly, and the diversion of funds to this work cut deeply into the monies available for levee work.

The base width of levees had been increased one third, and the yardage of dirt per station somewhat more, requiring considerably more dirt to be hauled and increasing the length of haul as well. All of these factors had to be taken into consideration in selecting or designing new types of equipment for this work. If the only factor entering into the problem were that of moving dirt, the choice would be easy; but there are many other considerations, such as soil, weather, length of haul, borrow pit condition, and type of levee section.

In a succeeding article I will discuss some of the types of machinery that have been tried out on the work recently, and will consider the probable new levee section based on the studies of the 1927 flood and its effect on construction equipment and methods.

Levee Construction in the Yazoo Section

Methods and equipments used in constructing setbacks and enlargements on a large scale

Setbacks and enlargement of levees on a large scale is going on in the Vicksburg Engineer District of the Mississippi River Commission, which extends from the mouth of the White River on the right bank and the Coahoma-Bolivar County line, Miss., on the left bank, to Warrenton, Miss., a distance of about 240 miles. Various methods of dirt handling are being employed by the contractors.

A series of contracts for levee construction along the Mississippi river about 40 miles north of Vicksburg illustrate a variety of present-day methods of earth handling in levee work. These contracts, Nos. 20, 21, 22, 23 and 24, aggregate about 1,690,000 cubic yards of earthwork, and involve both enlargement of existing levees and construction of new setbacks, necessitated by the encroachment of the river upon present levees. These jobs were in various stages of completion.

FIG. 1—MONIGHAN WALKING DRAGLINE, 4½ YD. BUCKET, 115 FT. BOOM, DIESEL OPERATED, TOPPING OUT LEVEE FOR STERNBERG CO.

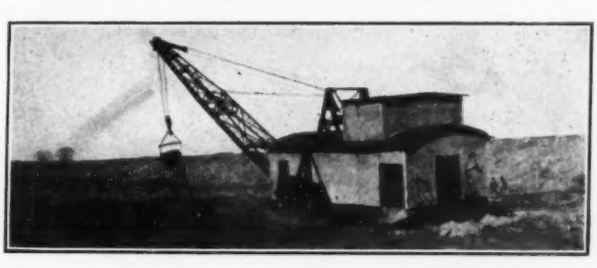


FIG. 2—MONIGHAN WALKING DRAGLINE, 2-YD. BUCKET, 65 FT. BOOM, BRINGING BORROW PITS TO REQUIRED SECTION

Standards of the Mississippi River Commission limit the depth and slope of borrow pits on the river side of the levees. On contract 23, a Monighan walking dragline with a 4½-yard bucket and a 115-foot crane, F.M. Diesel operated, obtains material from borrow pits to top out the levee. It is followed by a smaller Monighan, with a 65-foot boom and a 2-yard bucket, also Diesel operated, which works over the area, bringing the borrow pits to proper section—a 3-ft. drop and 1 to 50 slope. This section of levee, which was awarded to Sternberg Company, of St. Louis, Mo., involves 200,000 cubic yards of setback levee. The embankment amounted to 190,000 cubic yards, and the muck ditch and stumpage 5,000 yards each. The amount of bid was 26.99 cents per cubic yard. Contract 24 was awarded to the same contractor at the same price. It involved 125,000 cubic yards of riverside embankment, 15,000 cubic yards of banquette and 10,000 cubic yards of stumpage. The layout of the job and the new section is shown in Fig. 3.

Contract 22, involving 450,000 cubic yards at the price of 26.99 cents per yard, was sublet to Lowrance Bros. & Co., Driver, Ark., and Rogers Bros., Memphis, Tenn. These firms had a large and well maintained outfit, and moved dirt with horses, crawler wagons, tractors and elevating graders. Their equipment included eight Caterpillar "60"

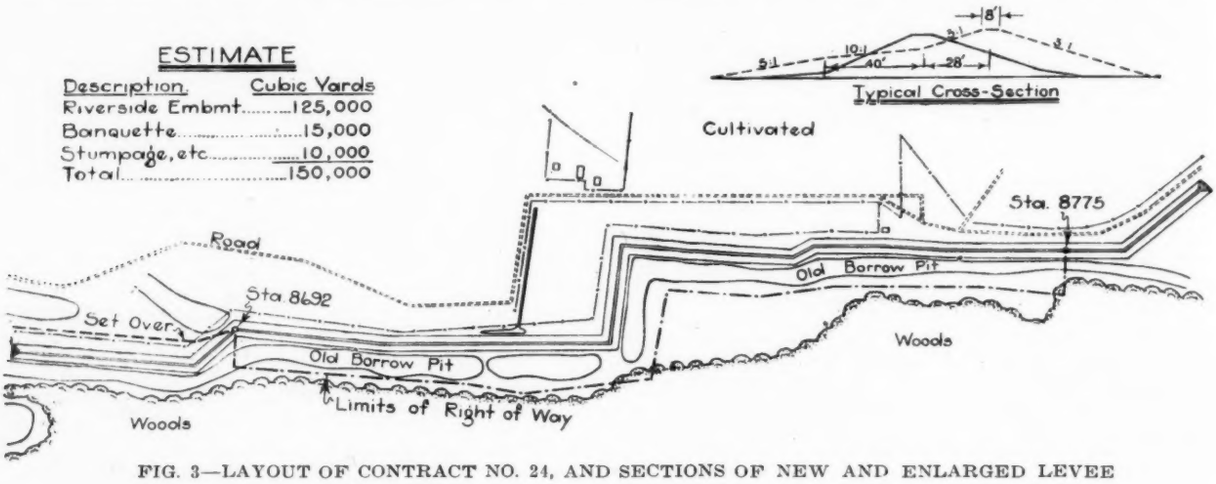


FIG. 3—LAYOUT OF CONTRACT NO. 24, AND SECTIONS OF NEW AND ENLARGED LEVEE

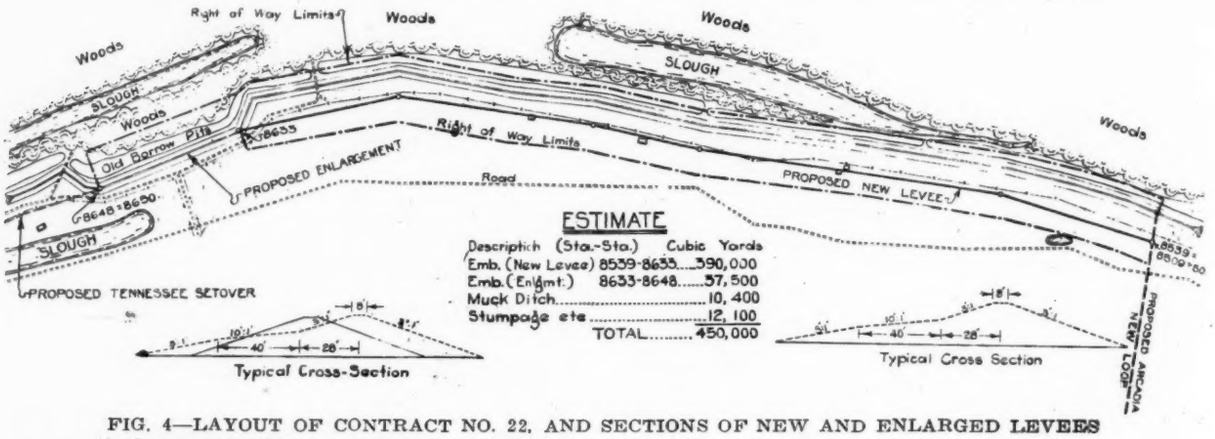


FIG. 4—LAYOUT OF CONTRACT NO. 22, AND SECTIONS OF NEW AND ENLARGED LEVEES

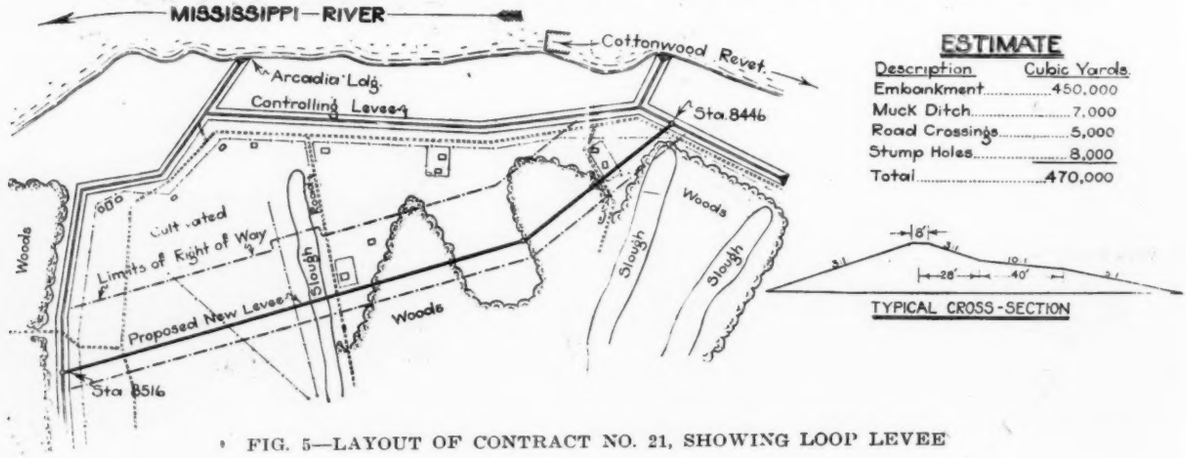


FIG. 5—LAYOUT OF CONTRACT NO. 21, SHOWING LOOP LEVEE

FIG. 7—RUSSELL ELEVATING GRADERS AND STREICH WAGONS HAULED BY "CATERPILLAR 60's" ON LEVEE WORK AT FITLERS. LOWRANCE BROS. AND ROGERS, CONTRACTORS.

tractors, three Russell "42" Giant elevating graders, one Austin-Western elevating grader, one Western 7-yard crawler dump wagon with Athey truss wheels, four 7-yard Streich crawler dump wagons, one Streich 12-yard crawler dump wagon, one Euclid 8-yard crawler dump wagon, and about twenty mule-drawn 1½-yard wagons.

The levee was brought completely to grade with this equipment. The crown was finished with an ordinary road grader drawn by four mules. Work was carried on in two 10-hour shifts, the job being lighted with electric lights supplied by an Arcola portable electric plant.

FIG. 8—RUSSELL GRADER "42" LOADING INTO STREICH 12-YD. DUMP WAGON WITH CRAWLER TREADS FRONT AND REAR

This job, which included both new construction due to a setback and enlargement, was built to the section and location shown in Fig. 4.

Contract 21, also awarded to Sternberg Co., covered a new loop or setback as shown in Fig. 5. It involved 470,000 cubic yards of embankment, muck, stumpage and road crossings. The contract price was 26.99 cents per yard.

The banquette of the section of levee was erected first, the dirt for this being taken sufficiently far in front of the levee (usually about 300 feet) so that drag lines could secure sufficient dirt for completing the section. However, on nearly all the work it was necessary to rehandle the draglined material, since not enough could be secured within reach of the dragline to complete the levee.

The material for the banquette was dug by elevating graders and loaded into wagons or trucks. There were two Russell "42" Giant elevators and one Austin-Western "Levee Special" powered with a Wisconsin engine which operated the apron and cutter. These were drawn by "Caterpillar 60" tractors. In addition, there were three Monarch "75" tractors hauling Western 7-yard crawler dump wagons, and about fifteen 4-mule teams. This crew worked two 10-hour shifts, using Carbic lights for illumination for night work.

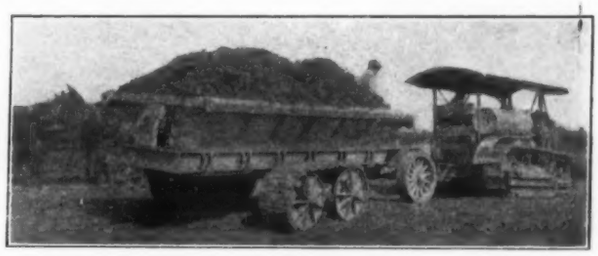


FIG. 9—"CATERPILLAR 60" HAULING LOADED STREICH WAGON FOR LOWRANCE BROS. & CO.

A portion of this contract was through a wooded area, and considerable clearing and grubbing was necessary. The usual method of clearing was to dynamite the stumps and then pull them out with mules.

The remainder of the levee section was completed with a Monighan walking dragline, equipped with a 4-yard bucket on a 115-foot boom. On most of this work, dirt had to be rehandled, and one throw-over of dirt was necessary by the dragline in order to secure enough to complete the section.

On the extreme eastern end of the contract a

FIG. 6—GENERAL VIEW OF WORK ON CONTRACT NO. 22

FIG. 11—MONARCH "75" HAULING WESTERN 7-YARD CRAWLER ON CONTRACT 21

hydraulic dredge was used to place the major portion of the section, leaving the crown of the levee to be placed by other means. The dredge, which was furnished by Wilbanks and Pierce of Memphis, Tenn., was brought up during a period of high water and put in place. It dredged the material from borrow pits, thin earth banks being thrown up to contain the dredged material. The process appeared to be successful, but much difficulty was encountered in getting the dredge back again into the river, which was then at a low stage. It became

FIG. 12—THE DREDGE ON CONTRACT 21 HAS DIFFICULTY RETURNING TO THE RIVER
Top works can just be seen above bank in center of picture.

necessary to dig through the levee, and by pumping water from the river, and locking the boat along, it had been brought nearly to the river at the time the job was visited.

The work on these contracts was done under the direction of the Vicksburg Engineer District of the Mississippi River Commission. Major J. C. H. Lee is district engineer and A. M. Todd, senior engineer, is principal civilian assistant; the Southern Area of the district, in which this work is located, is in charge of associate engineer W. M. Childs. George C. Thomas is superintendent and W. H. Holland inspector.

Cleaning Newton's Water Conduit

Wooden infiltration gallery after thirty-seven years' use covered with crenothrix growths several inches thick

The city of Newton, Mass., has a population of about 54,000 which is served by about 190 miles of water mains, the average water consumption being 78 gallons per capita per day. The supply is obtained from collecting conduits and wells. Two lines of 24-inch open-joint vitrified pipe about 3,200 feet long and receiving the flow from fifteen 2½-inch wells 40 feet deep, and a 30-inch concrete conduit 1,400 feet long, deliver the supply into the end of a wooden collecting conduit. Beneath the concrete conduit is a 12-inch open-joint vitrified pipe connecting to it at two points; an additional supply of slightly more than one million gallons a day is obtained through a 20-inch vitrified pipe about 2,200 feet long delivering into the end of the concrete conduit from a well 28 feet in diameter and 37 feet deep, in which are installed two motor-driven centrifugal pumps. The wooden collecting conduit is about 3,800 feet long, four feet square and laid with open joints, with the invert at elevation 81. Into it flow 185 2½-inch wells 40 feet deep. The conduit discharges through 53 feet of 24-inch pipe to a gate chamber and thence about 700 feet across the river to a stone conduit three feet square and 50 feet long, to the pump well with bottom at elevation 82.

The wooden collecting conduit was built in 1890 as an infiltration gallery and has been used continuously for the 38 years since then as a main source of supply. During an inspection made in 1927 it was found that very few of the 2½-inch wells are flowing. In April, 1927, the double line of 24-inch vitrified pipe, which was built in 1894, was abandoned as it was feared that the swamp from which it obtained its supply through the open joints might be a source of contamination, especially as it is frequently flooded by the rise in the Charles river.

It was known that the wooden infiltration gallery needed cleaning, and in March and April, 1927, it was scraped and thoroughly cleaned of growths and sediment. During this time the pumps were shut

FIG. 10—RUSSELL GRADER LOADING INTO WESTERN 7-YARD CRAWLER DRAWN BY "CATERPILLAR"

down and all the water was obtained from the Metropolitan supply. At two manholes along the gallery pumps were installed pumping directly from the gallery and discharging into the river, by which means the ground water along the gallery was lowered to the grade of 82, or one foot above the floor, enabling the men to enter the gallery for the work of cleaning. (The normal grade of ground water outside the gallery was about 87; the grade of Charles river is from 91 to 93.)

The scraping of the inside of the gallery was done by use of hoes with handles cut off to about one foot in length and other types of scrapers, and the material thus removed, after falling into the 12 inches of water left upon the smooth plank floor, was pushed by pushers or squeegees to the pumps and the whole pumped into the river.

The work inside the gallery was necessarily done under unfavorable conditions but was done in a very thorough and effective manner. The gallery is about 3,800 feet long and from 10 to 15 feet underground. Each of the men was equipped with waist-high duck hunter's rubber boots, oilskin coat and hat, and a flashlight, in addition to the scraping tools. As the water was maintained in the gallery at one-foot depth, there was left but three feet of space in which to do the work. This naturally slowed down the work of cleaning. The water was held to the one-foot depth by two electrically driven centrifugal pumps, an 8-inch and a 10-inch, with suctions at the bottoms of the manholes, which were built to a slightly lower level than the floor of the gallery.

The material found upon the sides, roof and floor of the gallery had been accumulated for 37 years and consisted of growths and deposits caused largely by crenothrix, sometimes called "iron bacteria' and belonging to the mould family, which utilizes the iron in the water as food and precipitates it as ferric oxide, which causes the accumulation of flocculent masses. These were found clinging to the roof and side walls of the gallery forming a coating two to six inches thick; much of which, however, had fallen to the floor as the water was lowered by the pumping. The texture of the material was such as to permit its being held in suspension in the water and the masses disintegrated upon the slightest agitation. When this material was scraped off of the spruce and hemlock of which the gallery had been built, these were found to be perfectly sound.

Manganese also is present in the ground water in the form of a mineral salt. Large quantities of a sand-like material, composed of particles so fine as to blow away in dust when dried, was found upon the floor in large lumps and coal black in color. This material, like crenothrix, is not present in the supply in excessive quantities, and both are perfectly harmless. They may, however, have contributed in some measure to the volume and character of sediment which was found in cleaning the street mains.

While the water was pumped down for the cleaning of the conduit, an inspection was made of the line of 24-inch vitrified pipe 2,200 feet long and of 1,400 feet of a 30-inch circular concrete conduit, which carried the water from the 28-foot well to this gallery. The vitrified pipe had been built with cemented joints, but it was found that willow and alder roots had entered the pipe line through the cemented joints and had grown inside to such an extent as to nearly fill the pipe in places. It was also found that the circular concrete section was not in the best of condition, the concrete being somewhat porous, while cracks had opened at construction joints, creating a condition such that, if the pressure of ground water should at any time be greater than that of the well water inside, the ground water, perhaps of an undesirable nature, might seep in through the concrete and contaminate the water on its way to the gallery. It was decided to substitute cast-iron pipe with lead joints for this line, but in the meantime to keep the pressure of the well water on the inside greater than any possible pressure of ground water on the outside, by constructing a 10-inch iron standpipe at the end of the line as an outlet, requiring the pump to raise the water to grade 94.4 where it overflowed the top of the pipe and fell into the gallery; incidentally obtaining, perhaps, some advantage by aeration as it fell in an umbrella-shaped sheet from the top of the pipe. A few months later the new cast-iron pipe line was completed and the old pipe line was permanently abandoned.

During and prior to this work, about 32 miles of the distribution system was cleaned under contract by the National Water Main Cleaning Company, about half of the length being 19, 12 and 16-inch pipe, and the remainder being 6, 8 and 20-inch.

Use of Sewage Gas at Topeka

The sewage treatment plant of the city of Topeka, Kans., now under construction, is to utilize the gas developed by digestion of the sewage for three distinct purposes; for heating the sludge in the digestion tank, for heating the main building at the plant, and for burning screenings. The heating of the sludge is the primary use; the building will be heated by means of radiators receiving water heated by the gas. The use of gas as a fuel for burning the screenings will be a decided convenience, making possible the more frequent disposal of the screenings and eliminating the objectionable accumulations of them.

Cutting Steel Under Water

Cutting off steel sheet piling several feet below the surface of the water was found to be necessary in connection with the reconstruction of High Bridge, New York. A coffer dam had been built around the eastern pier, formed by driving two rows of interlocking steel sheet piling and pouring concrete between them. Upon completion of the bridge it became necessary to remove part of the coffer dam, the outer row of piling being withdrawn while the inner row was cut off two feet below low water, or about eight feet below high water. This was done by the use of oxygen, utilizing an equpment which had been developed and perfected during the past two years—the under-water cutting torch.

Briefly, this torch consists of a graphite electrode pierced with two small holes for oxygen. In operation, an arc is struck between the electrode and the metal to be cut. This heats the metal to the kindling temperature so that it is pierced quickly by the stream of oxygen issuing

from the holes in the electrode. The arc thus corresponds to the oxy-acetylene heating flame of the ordinary cutting blow pipe. The arc requires from 300 to 600 amperes at 50 volts.

The air compressor supplying air to the diver and a steam turbine-driven generator were located on a barge, while oxygen cylinders were placed on the pier, pressure in the oxygen line leading from the cylinder to the torch, which was held in the diver's hand, being controlled by a standard oxygen regulator. One of the electrical leads was grounded on the piling by means of a clamp, and the other was connected to the handle of the torch.

Although the web of the piling was only ⅜-inch thick, it was necessary to cut through nearly four inches of steel and concrete at each interlock. The diver cut an average of twelve standard 14-inch piles in an 8-hour day, including necessary interruptions.

Loading Test of a Reinforced Concrete Arch Bridge

Three-span concrete bridge, six years old, tested to destruction by North Carolina Highway Commission and Bureau of Public Roads. Conclusions as to stresses and deformations caused by live loads.

The North Carolina State Highway Commission built in 1922, as a Federal-aid project, a three-span concrete arch bridge over the Yadkin river, also known as the Pee Dee river, between Albemarle and Mount Gilead. In 1926 the Carolina Power & Light Co. began the construction of a dam on a site about nine miles downstream from the bridge. The water of the river, upon the closing of the dam, was to be backed up to such a height as to submerge the bridge and necessitate its replacement by a new bridge at a higher elevation. Between the time of completion of the new bridge and the closing of the dam, a period of several months, the old bridge was to be demolished so as to offer no obstruction to the flow of water in the river.

These circumstances presented a unique opportunity to test a modern, full-size, reinforced concrete arch bridge with moderately long spans. In recent years the popularity of the arch bridge has increased greatly because of its superior esthetic value and, in this country, millions of dollars are spent annually on this type of bridge alone. Consequently, there is a widespread tendency on the part of bridge engineers to embrace any idea which may lead to more economical or more satisfactory arch design without sacrificing safety. In departing from current practice, the judgment of the engineer is based more and more on data developed by the various research agencies of the world.

The North Carolina State Highway Commission, recognizing the opportunity to make this test, and desiring to make it as complete as the available time and money permitted, requested the cooperation of the Bureau of Public Roads.

The bureau acceded to the state's request, and the two agencies then jointly issued to various technical and scientific societies and colleges invitations to participate in the experiment by appointing one or more of their members to serve on an advisory committee.* The purpose of this committee was to formulate general plans for the test, and, by meeting from time to time, assist those in active charge in the solution of problems which would certainly be encountered during the period of the test, and assist in interpreting the results. The advisory committee first met in April, 1927, and formulated general plans; several meetings were held during the course of the test, and at a final meeting on November 8, 1928, this report was approved by the committee.

The methods and results of the tests made are reported by Albin L. Gemeny, senior structural engineer, Bureau of Public Roads, and W. F. Hunter, designing bridge engineer, North Carolina Highway Commission, in the December issue of "Public Roads," the official publication of the U. S. Bureau of Public Roads. This report occupies twenty-four pages, describing in detail the methods and measuring instruments employed, the data obtained, and the conclusions derived therefrom, and the application of them to arch design; while in the January issue of the same publication J. T. Thompson, highway research specialist, Div. of Tests, Bureau of Public Roads, and also associate professor of civil engineering, Johns Hopkins University, reports on a cooperative study, made at that university by himself and Mr. Gemeny, for developing a model analysis of a reinforced concrete arch.

The objects of the test were outlined in the report as follows:

(1) To compare the measured deformations of a full-size, reinforced concrete arch rib with the deformations as determined by the theory of elastic structures, when the rib carried loads producing stresses of moderate intensities, and was as free as practicable from the restraining action of the superstructure.

(2) To make the same comparisons when the rib carried loads which produced stresses of high intensities.

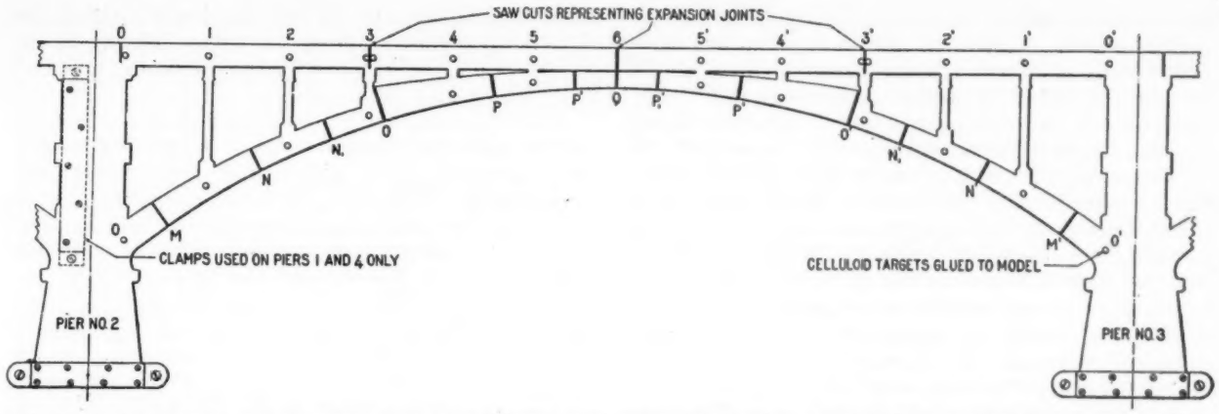
(3) To determine the effect of the superstructure on rib deformations by comparing deformations measured when the superstructure was intact and the measured and computed deformations of the rib free from restraint by the superstructure.

(4) To compare the measured deformations of the rib, both with and without the restraining action of the superstructure, and the deformations as determined from an analysis made by the use of an elastic model.

Gemeny and Hunter's report carries the following conclusions as to the action of a reinforced concrete arch, apparently justified by the data presented:

(1) The action of an arch rib, when free from the restraining effect of the superstructure and supported by practically immovable piers, conforms closely to the action as determined by the generally accepted theory of elastic structures, even at high unit stresses over short lengths of the rib.

*The committee consisted of representatives of the University of North Carolina, North Carolina State College, Am. Ass'n of State Highway Officials, Am. Soc. of Civil Engineers, Am. Railway Engineering Ass'n., Am. Concrete Institute, Highway and Research Board, U. S. Bureau of Standards, Am. Soc. for Testing Materials, U. S. Bureau of Public Roads, and North Carolina State Highway Com'n.


SAW CUTS REPRESENTING EXPANSION JOINTS
CLAMPS USED ON PIERS 1 AND 4 ONLY
CELLULOID TARGETS GLUED TO MODEL
PIER NO. 2
PIER NO. 3

OUTLINE OF MODEL OF YADKIN RIVER BRIDGE, SHOWING SECTIONS AT WHICH GAUGES WERE ATTACHED

(2) The observed compressive stress in the concrete at any section of the rib checks the computed stress more closely when it is assumed that the concrete takes tension than when it is assumed that concrete is not active in resisting tensile stress, even where the high tensile stress causes cracks in the concrete.

(3) The observed tension in the steel was, in general, less than that computed by assuming the concrete to take no tension.

(4) The superstructure in an open-spandrel rib arch greatly reduces the deformation of the rib; the amount of reduction depending upon the degree of continuity of the floor system, the manner in which the floor system is attached to the tops of the spandrel columns, and the stiffness of the columns.

The use of expansion joints of the sliding type in the floor system of this bridge apparently did not prevent the coaction of the superstructure with the arch ribs.

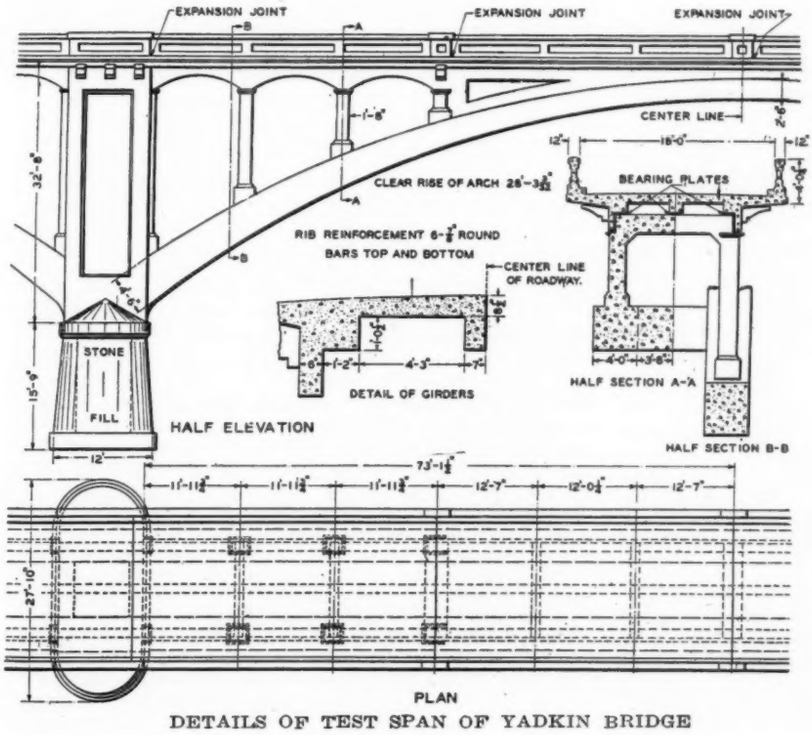
(5) A quantitative determination of the effect of the superstructure on the arch may be made by the use of the Beggs deformeter gauges on an elastic model of celluloid or some other suitable material, if all members are connected in a definite way. While it seems possible to get a reliable model analysis when the structure has frictional joints such as the floor bearings of the Yadkin River Bridge, there is no practical means of making a model which represents such joints with certainty.

(6) Temperature deformations of the rib appear to be independent of the superstructure for this particular arch.

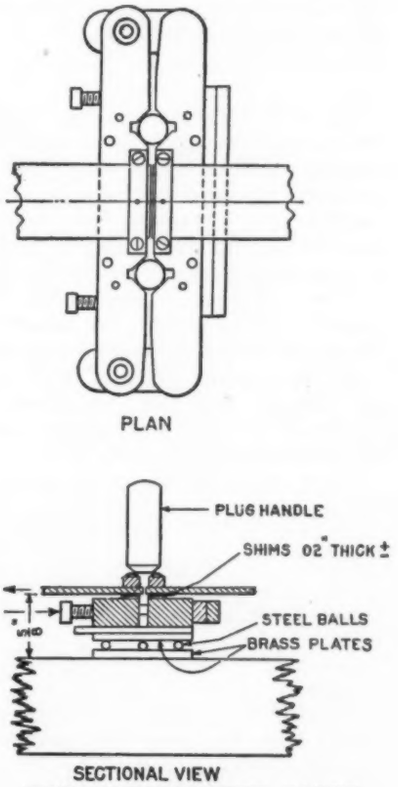
These tests were concerned only with deformations produced by live loads applied over comparatively short periods of time. The conclusions are not, therefore, necessarily true of dead-load deformations due to continuous application of the load over long periods of time because of the possibility that the elastic properties of the concrete may be changed by a continuously applied stress.

It may be inferred from the first conclusion that, even though the dead-load stresses are kept down to a low value, the combined dead and live load stresses may be safely allowed to reach a much higher value, depending upon the quality of concrete which may be secured in the work.

Conclusions 4 and 5 indicate that, if full advan-



DETAILS OF TEST SPAN OF YADKIN BRIDGE



BEGGS DEFORMETER GAUGE

tage is to be taken of the stiffening effect of the superstructure, a type of structure must be used which can be accurately represented by a model. In order to do this, sliding joints should be eliminated from the structure as far as practicable and definite connections made between all members. It should be pointed out, however, that, if full advantage is taken of the reduction of rib stresses due to the stiffening effect of the superstructure, a complete investigation should be made of the accompanying increase in the stresses in the spandrel columns.

TEST BRIDGE DESCRIBED

The test bridge consisted of three 2-rib open-spandrel arch spans of 146 feet 3 inches clear span and 28 feet 3 inches rise, with seven 42-foot 6-inch deck-girder approach spans at each end. The floor system of the arches rested on sliding bearing plates at each panel point. These plates were found to be badly corroded and probably had ceased to function freely as sliding bearings. The intermediate arch piers below the springing line were of hollow construction, the hollow space being filled with field stones. The end arch piers had buttresses on the shore side to increase their resistance to overturning under the unbalanced thrust. The piers were founded on solid rock.

The bridge was built by contract, using cement and reinforcing steel furnished by the state highway commission. The coarse aggregate consisted of crushed field stones found in the vicinity of the bridge site. Inspection of the aggregate in cores taken from the bridge disclosed several varieties of stone, all of which were apparently hard, sound, and durable. The fine aggregate consisted of a mixture of 5 parts of sand to 1 of stone screenings. A well-known brand of Portland cement was used.

The concrete for the piers below the springing line was mixed in the proportions 1:2½:5 and, for the remainder of the bridge, in the proportions 1:2:4. Tests of 6- by 12-inch cylinders of the 1:2:4 concrete made at 28 days showed strengths of 2,140, 1,900, 1,655, and 1,258 pounds per square inch, each of these strengths being for a single cylinder representing about 50 cubic yards of rib concrete and the strengths are given in the order of location of the batch from springing line to crown. Inspection records do not show clearly which of the arch spans is represented by these cylinders.

The reinforcing steel consisted principally of round, deformed bars of intermediate grade steel. Some of the minor reinforcing consisted of square, deformed bars. Tension tests on the steel showed an average yield point of about 48,000 pounds per square inch and an average ultimate strength of 75,300 pounds per square inch.

Cuts made in the concrete for installing instruments, taking test specimens and destroying the continuity of the superstructure showed dense, hard concrete apparently of good quality. The steel, where the covering of concrete was stripped off, showed clean surfaces, free from all signs of corrosion.

In making the tests, a span was loaded and various resulting deformations measured. The loads applied consisted of tanks containing water pumped into them from the river; the amount contained varying in different tests at each position so as to give total weights of 47,000 lbs. (the weight of the empty tank), 138,000 lbs., 229,000 lbs., and 320,000 lbs. The weight was supported on four bearing blocks located over the centers of the columns at which the loads were to be applied.

The test was divided into three phases. First, a single tank was placed so as to apply its load at two adjacent panel points, and deformations observed over the entire rib from springing line to springing line with the superstructure intact. This series of loadings began at a pier and continued successively to the crown. Next, the same procedure was followed except that the deck and railings were cut at each panel point and supported on new, greased bearing plates so as to destroy, as far as practicable, the continuity of the floor system and its restraining action at the tops of the columns, and the curtain wall near the crown was broken out. Finally, two tanks were placed in the position to produce the maximum stress in the rib and the deformations were measured with the superstructure in the same condition as in the second phase.

Measurements were made of (1) Deformations of the concrete on the extrados and the intrados at nine sections of the rib spaced 18 feet 6 inches apart along the axis. (2) Deformations of the reinforcing steel near the springing lines and at the crown. (3) Rotation of the arch axis at nine points spaced 18 feet 6 inches along the axis. (4) Deflections of the rib at nine columns, no measurements being taken at the column next to each pier. (5) The change in length of mid-ordinates of each of the thirty-one consecutive 5-foot arcs of the axis. (6) Rotation and horizontal movements of the piers.

Deflections of ribs and horizontal movements of piers were measured by means of wires. Thermometers were placed in holes drilled in the ribs at different distances from the surface of the concrete, the holes filled with cup grease and closed with corks through which the stems of the thermometers passed. Observations over a period of several months showed an average movement of the crowns of both ribs of the center arch span of one-fortieth of an inch for a change of 1° C. in average rib temperature.

USE OF MODEL FOR ANALYZING STRESSES

The investigators used a method of analyzing indeterminate structures, developed comparatively recently by Professor Beggs, of Princeton University, which consists in studying the elastic action of a model, each member of which is of the same relative stiffness as the corresponding member of the structure. The Beggs method is further described by Professor Thompson as follows:

Suppose it is desired to determine the thrusts, shears, and moments in the arch rib of a structure, the model of which is shown in Figure 2. The model is prepared from a sheet of celluloid approximately one-tenth of an inch thick, the sectional dimensions of the model being proportional to the cube roots of the moments of inertia of the various sections of the actual structure according to some convenient scale. If we wish to determine the thrust at M, for example, due to a vertical load of unity at 4, we can do so by cutting the arch rib at M normal to the rib axis and separating the sides of the cut a small known distance d_1, care being taken to keep the sides of the cut parallel. This displacement of the sides of the cut produces distortions throughout the model, and if we measure with a microscope the resulting vertical deflection d_0 at 4, we have all the data necessary for computing the thrust T at M. This follows from the Maxwell theorem of reciprocal deflections and Müller Breslau's principle that any in-

fluence line is a deflection diagram. It is necessary, of course, that d_1, and d_2 be measured in the same units (say inches) and this is accomplished by multiplying an observed deflection by the calibration factor of the microscope. It is obvious that if similar measurements are made of the vertical deflections at points 0 to 6 due to the displacement of the cut section M, an influence curve can be plotted for the thrust at M.

By the same reasoning an influence diagram for the shear at M can be determined by measuring the vertical deflections at points 0 to 6 due to a small known shear displacement of the sides of the cut section.

Likewise, if the two sides of the cut section are rotated with respect to another through a small known angle and the necessary measurements of deflections made, an influence diagram for bending moment at M can be plotted, the only difference being that in the case of moments the scale of the model plays a part; it is necessary to multiply the deflections d_2 by the scale of the model. For example if the scale of the model is 1 inch to 5 feet, all observed deflections must be multiplied by 5, to obtain the moment in foot-pounds. That is, the deflections d_2 for a given angular rotation in the model must be multiplied by the value of a unit length of the model in the actual structure to obtain the deflection in the actual structure for the same rotation. In the example given the model deflections would be multiplied by 60 to obtain the moment in inch-pounds due to a load of one pound and by 5 to obtain the moment in foot-pounds.

The foregoing paragraphs set forth the principle upon which the Beggs method is is based. In practice the displacements of the sides of the cut section are brought about by means of a deformeter gauge and plugs which are inserted therein. The gauge consists of two steel bars drawn toward each other by springs. In the opposing sides of these bars are notches into which the plugs are inserted. The model is first attached to a drawing board by clamps attached at points of fixity in the actual structure such as the bases of piers, etc. The underside of the model lies in a plane five-eighths inch from the drawing board and is supported at numerous points upon ½-inch blocks of glass or metal and ⅛-inch steel ball bearings. The gauge is attached to the model, normal to the axis along which the thrust acts, and is supported upon two 1/16-inch plates between which three ⅛-inch steel ball bearings have been placed. Two normal plugs, midway in size between the large and small thrust plugs, are inserted before the gauge clamps are tightened. After screwing the clamps down tightly against the model the normal plugs are removed and the model cut through with a hack-saw blade. Thereafter, whenever the normal plugs are inserted the model resumes exactly the position it was in before the section was cut.

Thrust measurements are made by inserting first the two exactly similar small-size thrust plugs, reading the microscopes, which are of the filar micrometer type, and then inserting the large-size thrust plugs and again reading the microscopes. The microscopes are so oriented that vertical deflections are recorded by them and the differences in settings are the deflections d_2.

Shear displacements are produced by inserting the shear plugs, which are also exactly alike, with the flat portion bearing first against the faces, 1, of the notches and then against the faces, 2. This causes one side of the gauge to be displaced laterally with respect to the other side, the sides of the cut section remaining parallel and exactly the same distance apart as when the normal plugs are in place. The moment displacements are produced by inserting the two moment plugs, which are of different diameters, and then interchanging them.

In making the model of the Yadkin River Bridge the total moment of inertia of the concrete plus n times the moment of inertia of the steel was first computed for each of the various sections of the actual structure and the sectional dimensions of the model were based on the cube roots of these quantities. The scale of these sectional dimensions was selected so that the width of the arch rib did not, in general, exceed a size that could be grasped by the clamps on the gauges. This resulted in the selection of 1 inch to 5 feet as the proper scale, and a model approximately 100 inches long, since the bridge consisted of three equal arches of approximately 150 feet clear span each, a total of about 500 feet from end to end.

The outline of one-half of the model was next carefully scribed on a thin sheet of aluminum and small holes drilled at frequent intervals along the scribed lines. This templet was then clamped to a sheet of 0.08-inch celluloid, 20 by 50 inches in size, and center punch marks were made through the holes drilled in the templet. These punch marks were later used in scratching the outline of the model on the celluloid. The templet was next clamped to a new position on the celluloid sheet and the process repeated. By taking advantage of the symmetry of the structure, much labor was saved in laying out the model on the celluloid and mistakes which would no doubt have been made in scratching directly on the celluloid were avoided. The two halves of the model were roughly sawed out with a copying saw and filed down to the outlines.

Canning Waste Treatment Studies*

Abstract of progress report on studies conducted by the Ohio Canners Association and the Association of New York State Canners, Inc.

This report covers the experiments made at Canal Winchester, Ohio, from August 24, 1926, to October 8, 1926, on the treatment of wastes from corn, succotash and lima bean packs; and the experiments made at Albion, N. Y. between August 9 and October 25, 1927, on the treatment of wastes from green bean and tomato packs; both under the supervision of A. Elliott Kimberly, of Columbus, O.

CANAL WINCHESTER EXPERIMENTS.

Treatment studies covered screening with fine mesh screens, chemical precipitation, chlorine sterilization, and oxidation of the screened wastes, at high rates, on lath and crushed lime filters and on sand filters. The amounts of the wastes and their character are summarized as follows:

Pack	Amount of waste*, gals.	Amount of condenser water†, gals.	5-day oxygen demand, p.p.m.	Suspended matter, p.p.m.
Corn	23.8	23,600	420 to 1680	1715 to 2701
Succotash	.125.	9,300	260 to 2550	988 to 1925
Lime beans	.257.	2,900	175 to 460	696 to 2044

*Per case of No. 2 cans. †Gals. per 24 hours.

Screening. A 4-foot North screen, 50 meshes per inch, removed up to 84.5% of the suspended matter in the corn wastes, from 65.6 to 88.5% in succotash and a maximum of 75% from the lima bean wastes. Screenings weigh 50-55 lbs. per cubic foot with a water content of from 85 to 89.2%, and are easily handled.

Chemical Precipitation. The effluent from

*Abstract, by H. R. Crohurst in "Public Health Engineering Abstracts," of a progress report published by the Ohio State Department of Health.

chemical precipitation, using 15 or 20 grains of aluminum sulphate, either alone or in conjunction with 5 and 8 grains of soda ash, was clear but highly putrescible. Unless ample dilution exists, this process is not useful in the treatment of corn, succotash and lima bean wastes.

Chlorine Sterilization. Chlorine applied to screened wastes in amounts up to 46 p.p.m. did not effectively retard fermentation.

Filtration. Lath and stone filters basis, 6 feet deep, operating on a trickling filter basis, modified the organic matter present in the raw screened wastes. Test units were operated at 2,400,000 gals. per acre per day, or 400,000 gals. per acre-foot. No odors were produced and no clogging of the filters occurred. Two sand filters 30 inches deep, operating on raw screened wastes at rates of 75,000 and 100,000 gals. per acre per day, produced stable effluents throughout the tests, without odors or surface clogging.

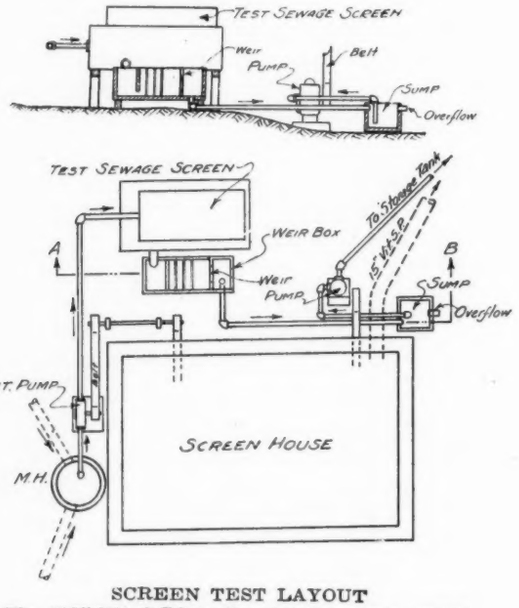
Silage liquor from corn has an oxygen demand 50 to 60 times the average wastes from corn canning, contains 54,000 p.p.m. of dissolved solid matter and is highly acid. The relatively small volume of the liquor suggests haulage in tank wagons and disposal on land as the best treatment.

ALBION, NEW YORK, EXPERIMENTS.

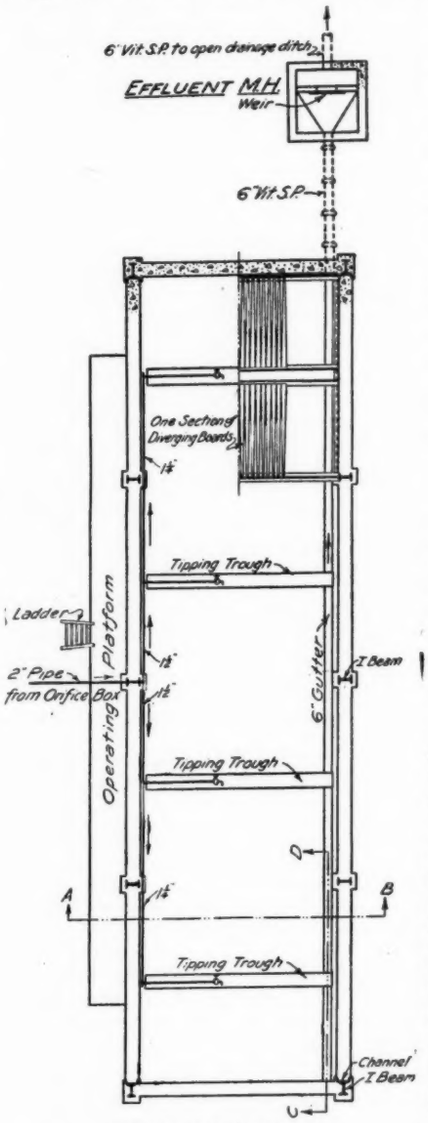
These tests covered the green bean and tomato products packs and were confined to determining the efficiency of oxidation processes. Some information was obtained on the wastes from dried bean canning wastes and from the wastes from the peak pack.

Rate of Flow. During the green bean pack, the average daily rate of flow ranged from 52,000 to 179,000 gallons, corresponding to packs of 411 and 2,280 cases, respectively. Average quantity of water used, 42 gals. per case, and the daily rate was nearly twice the actual volume of the water used. In the canning of tomato products the volume of waste water is large. At Albion it reached a maximum of 1,000,000 gals. daily. The actual volume of water used ranged from 69.5 to 94.0, or an average of 83.4 gals., per bushel on a pulping and peeling basis. On days of maximum production (15,200 bu.) the volume was less, reaching approximately 39 gals. per bushel of actual water used.

Oxygen Demand of Wastes. The 5-day oxygen demand of the green bean wastes ranged from 56 to 205 p.p.m.; average, 159. The pH ranged from 6.6 to 7.4 and phenolphthalein acidity averaged 6.6 p.p.m., ranging from 4.0 to 9.0. Tomato wastes contain pulp, seeds and fragments in suspension and exert an oxygen demand upon the stream oxygen corresponding to a 5-day demand of about 850 p.p.m. On maximum production days an average of 120 p.p.m. may be expected. Highly concentrated wastes are produced in dried bean canning. Soak and blancher liquors from a batch of 16,500 pounds of dried beans are approximately 1,550 and 388 gals., respectively, or 91 and 23.5 gals. per 1,000 lbs. of dried beans, with an oxygen demand of 5,500 and 10,500 p.p.m., respectively. Blancher dump liquor corresponding to red kidney beans and dried white beans showed a 5-day demand of about 3,700 and 3,600 p.p.m., respectively. From limited data, pea pack wastes which do not contain the stack and silage juices had a 5-day oxygen demand of about 140 p.p.m.



SCREEN TEST LAYOUT
The "15" Vit. S.P." is the regular sewer outlet.

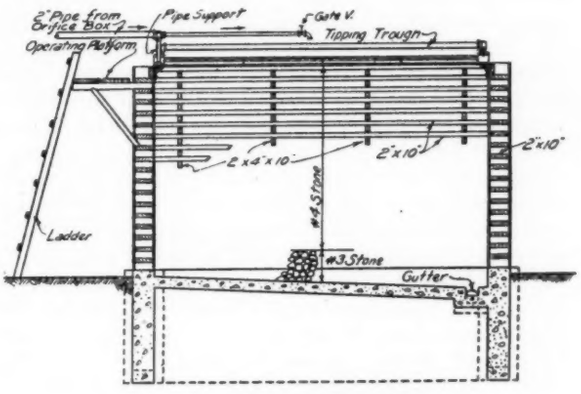


PLAN OF FILTER
Pipe from "Screen Test Layout" marked "to storage tank" leads to a circular tank, at the outlet from which is an orifice box, from which leads the pipe marked "from orifice box" in the above plan.

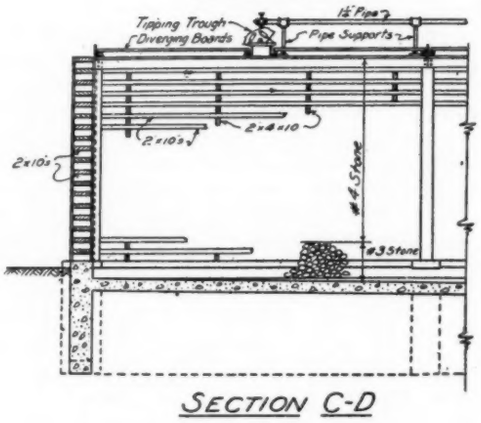
Sprinkling Filter. On screened waste from green bean canning, an 8-ft. filter composed of coarse limestone (size 1½ to 3¾ ins.), at a rate

of 2.0 m.g.p.a.d. operated 4.83 to 18.23 hours per day, according to production. A satisfactory effluent was produced with a 5-day demand ranging from 6 to 47 p.p.m., screened, and contained from 2.1 to 5.3 p.p.m. of dissolved oxygen.

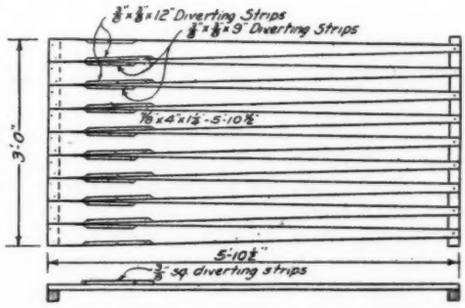
Screening. Special tests on the screening of tomato wastes were conducted. The two factory screens, operated in tandem, with average openings of 0.0600 and 0.00965 inches invariably clogged early in the tomato season, owing to excessive suspended matter in the wastes. Raw tomato wastes show suspended solids by volume (Imhoff cones) after two hours settling, under heavy plant operation, up to 12.6%. By weight, suspended matter ranges from 423 to 1,009 p.p.m. Considerable sand and grit is carried in the wastes, as indicated by the fact that 55% of the suspended matter is inorganic material. During the first 10 days of the tomato pack, the material intercepted on the factory screens was roughly 53 cu. yds. per million gals. of waste. The efficiency of a 20x20 mesh screen, with openings of 0.0350 inch, which replaced the factory screen did not exceed 49%. A 4x4-foot test screen, with average openings of 0.01185 inch operated at 4 r.p.m., successfully handled tomato products wastes at a rate of 100 g.p.m. Based on this figure, a larger North-type screen 6 ft. diameter and 10 ft. long would continue in non-clogging operation with unscreened waste applied at a rate of about 528,000 gals. in 24 hours. The screenings from the 4x4-foot test screen were very wet and the volume correspondingly large, ranging from 61 to 95 cu. yds. per million gallons of waste. Gravimetric determinations of total, volatile and fixed solids in the influent and effluent of the screen showed an average removal of the total suspended matter of only 36.2%, ranging from 18.2 to 50.6%. It is evident from these figures that screening alone will not suitably prepare tomato wastes for subsequent treatment in oxidation devices, although they form a very essential part of a treatment plant, removing practically all of the seeds and coarse fragments of the vegetable.



SECTION A-B



SECTION C-D



DETAIL of DIVERGING BOARDS

FILTER DETAILS

Trickling Filter. The trickling filter operated on screened and settled wastes from 6.63 to 15.25 hours daily, corresponding to actual applications of from 7,960 to 18,200 gals. per day. The actual volume of the waste treated slightly exceeded 4% of the total factory flow. The results of filter treatment indicated a material oxidation of the dissolved organic matters, but not to an extent to produce an entirely stable effluent. Data indicate a 5-day demand of the effluent of 110 p.p.m., suggesting a dilution of at least 4 to 1 to prevent stream oxygen reduction and the destruction of fish. The filter reduced the hydrogen ion concentration of the waste, which at times showed a pH of 4.8, causing the effluent pH to be well on the alkaline side, showing that a neutralizing program is necessary in the oxidation of screened settled tomato products wastes.

The tests were continued at Albion, N. Y., during the 1928 season under the auspices of the Association of New York State Canners, Inc., supervised by Mr. Kimberly, with analytical control by the New York State Department of Health, but the report on these is not yet available.

Vision at Highway Intersections

Among the improvements being carried on by most highway departments is the removing of obstructions to view at highway intersections, such as banks, trees, shrubbery, etc. The purpose, of course, is to prevent collisions between vehicles using the intersecting roads, and the general impression appears to be that it is effected. An English county engineer, G. H. Jack, in an article on "Road Maintenance in Herefordshire," states that widening corners and substituting open fences for hedges does not reduce accidents but as a matter of fact the number of accidents has actually increased on several corners which have thus been improved. Some have

more dangerous they are," and he said that it would be quite true to say that corners thus made safer for the average road user, are more dangerous to careless and incompetent drivers who imagine that all danger has been removed.

This reasoning is similar to that which explains the fact (brought out by accident censuses in this country) that more accidents occur on straight, level highways than on curves and steep grades, by the more caution observed by drivers where danger is evident, while they "step on the gas" on long,y level tangents.

Toll Roads and Bridges

Increasing use of them. Arguments for and against them. Privately owned toll bridges generally considered contrary to the public good

In the discussion of a paper before the American Society of Civil Engineers, Arthur Hirst, consulting engineer of Madison, Wisconsin, said:

One of the most striking developments in the history of highways is the present tendency of the American public to turn, in an unprecedented degree, to the construction of the larger bridges and tunnels rendered imperative by the demands of traffic. In order to pay for them, they are turning back 100 years and more to the toll system, because it has been found impossible to sell these works directly to the public even when economically justified. They can be sold to bankers but not to the public. The speaker ventures the prediction that Americans are about to enter upon the most tremendous era of toll-road construction in the history of this country, simply because the economics of the situation demand them. The public is unwilling and unable to pay in mass for what they will gladly pay on the installment plan, as they go, in the form of tolls. In most cases they have proved quite willing to pay in the form of tolls (gasoline taxes, now in effect in 45 states), for highway improvements. Gasoline taxes are nothing in the world but a return to the old toll-gate in a different form; he who uses the highway pays in proportion to that use. . . . It is the speaker's experience that the average American citizen prefers to pay $10 when and as he pleases rather than have the government tell him that he must give it 10 cents.

Evidences of the increasing interest in toll roads can be found in numerous statements and news items in both the technical and daily press. It is announced, for example, that a corporation to be known as the New England Express Highway Company will petition the Connecticut Legislature for a charter to operate a toll highway through that state, and for similar charters from Massachusetts and New York, with the idea of making an express through route from New York to Boston. The Empire Toll Bridge Co., a New York corporation, last November purchased the Walnut street bridge over the Susquehanna river at Harrisburg, Pa., which it will operate as a toll bridge. Items in PUBLIC WORKS during the past year have told of toll roads which are to be built between leading cities of England. Such roads have already been started in Italy, and the automobile clubs and other organizations in Berne, Switzerland, and vicinity are petitioning the Cantonal government to construct a through automobile toll road between Berne and Thun, a distance of about 23 kilometers.

The chief argument for the toll road is that it causes the cost of the construction and maintenance to be borne by those who use it, each in proportion to his use, which seems to be an equitable method of distributing the burden of cost. An argument for *private* ownership of toll roads and toll bridges is that it would provide structures of such large cost that the public treasury could not or would not bear the burden. In the January issue of PUBLIC WORKS we quoted the opinion of the Bureau of Public Roads with respect to toll bridges, which is that the maintenance of private toll bridges along routes of state or federal highways should not be tolerated, as the public money is then used for building an approach to an enterprise operated for private gain. The same adverse argument would apply to a toll road forming part of a state or federal highway route, but not necessarily to such a road built independently of through public roads.

At the 14th annual meeting of the American Association of State Highway Officials, J. S. Watkins, Kentucky state highway engineer, declared himself opposed to privately owned toll bridges, stating that the only service rendered by a private toll company is to furnish capital for bridge construction, and the state can render this service equally as well by issuing bonds, either as an obligation of the state or as a lien against the improvement.

Last February the directors of the National Automobile Chamber of Commerce passed resolutions opposing "any effort to place control of any part of the public highways in the hands of private promoters"; while the year before they had adopted resolutions that "wherever toll bridges become necessary, these should be financed from public bond issues and should remain as toll bridges only until such time as the cost of the improvement has been defrayed, and should forever after be free to all; and that if public funds can not be made available, the right to build and operate toll bridges should be granted to private parties only after a most careful and searching inquiry and with definite understandings that such franchises shall be limited in nature and shall continue only for such periods as will provide a reasonable return. Thereafter bridges shall become public property and be free to all. In all cases the construction and operation of such bridges should be under the control of state highway departments whose duty it shall be to see that the public interest shall be fully safeguarded."

A. J. Brosseau, president of Mack Trucks, Inc., said: "There is this fundamental difference between toll roads and toll bridges: The public must use the bridges, as they are invariably located at strategic points of heavy traffic where there is no optional route Not so with the toll road, which would be simply an alternative highway."

Advocates of toll roads advance the argument that private enterprises could obtain right-of-way at fair prices by going quietly about it, which a state or federal government could not do, and with the latter politics also might enter to the disadvantage of the state. Also, that the building of high-grade roads for express traffic might lead to the devoloping of advances in road design and economies in road building, since private companies would demand the most efficient construction methods and results in order to insure a highway which would withstand the heavy traffic expected with the minimum cost of maintenance. It has been suggested that some

railroads might find it desirable to remove the rails and ties from unprofitable branches and use the road bed for motor traffic.

The construction and maintenance of *publicly* owned toll bridges may sometimes be justifiable. Tennessee has started a program of toll bridge construction involving an expenditure of $11,500,000; Arkansas is spending several million dollars for state-owned toll bridges, and Kentucky has recently sold $25,000,000 bonds to finance the erection of new toll bridges and acquire certain privately owned bridges. While the Bureau of Public Roads will grant no federal aid to a road which carries traffic to a privately owned toll bridge, it will grant such aid in the case of toll bridges owned and operated by the state.

While there are minor differences of opinion, there seems to be practically unanimous belief among road users and officials that requests for franchises for toll bridges, and possibly for toll roads also, should be scrutinized carefully and the matter studied thoroughly before such requests are granted, and that recapture provisions should always be included in franchises; and that franchises be refused on general principles except in case of urgent traffic requirements which the public highway departments can not meet.

State Purchase of Toll Bridges

Proceedings are under way for purchasing the last two toll bridges across the Delaware River connecting New Jersey and Pennsylvania, those at Delaware and at Dingman's Ferry, Pa., by condemnation.

A bill in the Maryland House of Delegates provides for the purchase jointly with the state of Virginia of the toll bridges across the Potomac River at Point of Rocks and Brunswick, Md.; the bridges to be continued as toll bridges until the cost of purchase has been recouped.

Standards of Municipal Service

Discussion before Governmental Research Association of report of a joint committee on this subject. Results vs. Methods

Last year a committee known as the National Committee on Municipal Standards was created under the joint sponsorship of the National Municipal League, the Governmental Research Association, and the International City Managers' Association. At the annual meeting last fall of the Governmental Research Association, this committee, through Clarence E. Ridley, secretary, made a brief progress report. Only an organization meeting had been held, following which a leaflet was prepared and sent to the members of the sponsoring organizations, with a view to determining the amount and character of interest in the subject, and revealing the latent sources of assistance upon which the committee might draw. This leaflet appeared to arouse very little interest in the members.

However, it had been decided at the meeting of the committee that one municipal service should first be studied exhaustively in an effort to establish a technique which might be applicable to other services. The service selected was street cleaning; and realizing the necessity of getting the cooperation of men in the field who must use the standard, the International Association of Street Sanitation Officials was invited to work with the committee in devising a unit of measurement and a means of applying it to this particular service. The response of this organization was prompt and definite. The Sanitation Officials asked for a memorandum setting forth the manner in which they could cooperate, and this being furnished, promptly advised that a committee would be appointed for the purpose at the next annual conference. "The spirit of cooperation shown by this organization gives great promise of what we may be able to accomplish by the enlistment of all similar organizations having a special interest in some particular activity of municipal government; by carefully coordinating their work, we shall be able to maintain a uniformity in the type of standards developed. Such a policy will aid not only the development of standards along practical lines, but it will also be some assurance, at least, of their acceptance."

This brief report was followed by considerable discussion. Dr. L. G. Upson, of the Detroit Bureau of Governmental Research, stated that "in establishing these standards it is always important to examine the machine itself, for it can be assumed from the structure of the machine that in general such results will probably follow. . . . It is on this principle that the fire underwriters rate a community by taking an account of its equipment for fighting fire, and of the organization of its fire force."

This idea, however, did not meet favor with other speakers, Mr. Ridley pointing out the possible risk in putting the emphasis on methods and machinery rather than upon results. In the first place, he said, if an appraisal of a service or activity is based upon the machinery employed, it is likely to be misleading. He cited as an example the fact that an adequate water supply for a city and the availability of modern fire-fighting equipment fully manned do not necessarily mean a low fire loss. Secondly, he said, such a course is likely to lead cities to ape one another and follow the methods used by each other with the hope—oftentimes false—that what is apparently successful in other places will be likewise beneficial to them. If the committee should decide to proceed on the basis of methods and machinery instead of results as a criterion of effectiveness, it is pertinent to observe that not many people can agree upon either the form of organization or the methods which would yield the best results. On the other hand, agreement on the result or objective is more likely; for example, all can agree that the objective of a fire department is to prevent fires and to extinguish with the least possible loss those that do occur. The fact that a certain type of equipment is used or that the fire chief is appointed instead of elected, is of secondary importance.

It is quite true, said he, that machinery and methods should not be left out of the consideration entirely, but it would seem that better and more lasting progress can be reached by going about this task of developing measurement standards for the various municipal services uninfluenced by preconceived ideas about any particular methods by which those services are obtained.

He listed five steps as an illustration of the method of procedure he had in mind. These, however, he did not offer as a finished product, but merely as indicative of the problem as he saw it:

1. The identification, exactly stated, of the service or activity.
2. The determination of a standard that will measure the results of the service or activity.
3. The designation of a cost unit in which the standard is to be expressed.
4. The determination of factors that comprise the cost of the service or activity.
5. The development of an impersonal means (methods and instruments) of applying the unit of measurement of result to the service or activity.

John Ihlder, of the Pittsburgh Housing Association, also stated that it is easy to place too much emphasis on the governmental machine; when conditions are right, particularly when public opinion is aroused, almost any agency will work well. He suggested that sometimes an ideal standard might be used, citing the practice of one German city which measures the efficiency of its fire department not by the value of the property destroyed by fire, but by the number of fires that do not extend beyond one room.

Some Ideas on Contract Letting

Should contractors be required to qualify financially? Giving contractors guaranteed information concerning subsurface conditions

In a discussion before the American Society of Civil Engineers of a paper presented to that society on the subject of "Letting Construction Work by Competitive Bidding," interesting opinions on certain phases of the subject were expressed by several members, among them John C. Wait, a lawyer-engineer and the author of some of the best known books on law for engineering practice; and Edward W. Sterns, assistant to the bridge engineer of the Port of New York Authority.

Mr. Wait gave expression to one of the few adverse criticisms of the proposal to require a contractor to prove himself to be thoroughly reliable, financially and otherwise, before a contract will be awarded to him or a bid will be received from him. "In the city of New York," said he, "some of the greatest projects and the biggest contracts have been undertaken by unknown contractors without personal finances. Some contractors have done New York's greatest work and have gone penniless to the grave. Some of the greatest buildings, bridges, tunnels and subways have been successfully built by men who could scarcely be expected to undertake great work. The policy that is recommended in this paper is now developing in the municipalities and in the states; that is, the policy of investigating the financial strength and experience of contractors. Public officials are being authorized by law to determine the reliability, responsibility, and capability of contractors and they are doing so to the fullest extent. The great Manhattan bridge was built by a contractor who owed his bank thousands of dollars; who did not even have funds with which to begin the work; who was opposed by all the steel companies in North America; and yet who built the bridge in the shortest time in which any suspension bridge had ever been built, and there was not one complaint or law suit that followed its completion.

"Now, why select contractors who are successful, who have great financial and political backing, and who have great experience, when there are others who are not so fortunate nor so successful but who can carry out the contract? Some of the biggest public works being built today are by contractors who were not known to have financial backing or experience, and the contracts are being successfully completed. Low prices do not always come from big and successful contractors."

Another more or less common practice which is opposed by Mr. Wait is that of disclaiming any legal responsibility for information given to a contractor in connection with bidding for proposed contracts, relative to conditions underground, based upon statements made by the engineer as to what was found by borings or other sub-surface explorations. 'The engineer," he said, "makes soundings or borings; he determines quantities, the elevation of water surfaces or sub-strata, the character of excavations, the presence or absence of materials of construction, etc., at great expense to the owner or municipality. Then what is done? The contractor is told that nothing is known definitely about these quantities and conditions; that the owner will not be held liable; and that the contractor must be responsible for them. In a week or ten days he must get information that the engineers may have taken nine months to collect at a cost of thousands of dollars. . . . This is done to protect the owner from the possibility of adverse court decisions if the judgment and knowledge of the engineer should prove to be inexact."

"Owners may be sure that the contractor will add to his price because of the repudiation of the engineer's estimate"; or, on the other hand, that they would give a lower price if the owners would back the engineer's estimate and accept responsibility for same. He suggested "writing to 100 or 1,000 contractors and asking how much they would decrease their bids to a municipality if they had a positive declaration as to quantities and conditions existing on the proposed work and if they were not required to guess or take information from engineers only to have it later repudiated in the "notice to bidders."

"To deny or refuse to support the engineers' reports, is an act that deprives the owner or municipality of the money spent for engineering and investigation. The contractor must then be responsible for engineering data obtained by the owner and he adds a liberal amount to his bid or contract price accordingly." The present tendency is "to make of the contractor a casualty insurance company by forcing him to indemnify the owner not only for any negligence of himself or anybody that may act for him, but for anything at all that may happen—even under the direction of the engineer."

It is possible that these arguments of Mr. Wait will have more weight in the future than they might have had in the past because of court decisions on suits brought by contractors against the Passaic Valley Sewerage Commission during the past two years. It will be remembered that in these decisions the court held that the engineer had deliberately misled the contractor as to subsurface conditions, misstating the results of borings and explorations made, and that the sewerage commission was therefore responsible to these contractors for several hundred thousand dollars which it had been necessary for them to spend in prosecuting the work because of the variation of conditions from those represented by the engineer.

Mr. Sterns, however, does not altogether agree with Mr. Wait on these points. He says that he "thoroughly believes in subsurface explorations, commensurate with the importance of the work involved, and believes further in furnishing to the bidder the complete information that he obtains from such explorations exactly as he receives it." But he "does not believe in guaranteeing to the contractor either the correctness of the subsurface exploration or that the conditions indicated by them will be found actually to exist; or, in other words, that the interpretation as indicated by the plans is correct. Those risks must be and should be taken by the contractor." He does not, however, think that this should apply to subsurface man-made structures. It should be possible to locate all such structures definitely, and their existence and location should be shown upon the plans and the owners should hold themselves responsible for such information. He cites one instance in which, while the pipes and other underground structures were supposed to be shown upon the plans, there was encountered a 24-inch high-pressure water main which had not been so shown; and in this case "the equity lay only in the owner assuming both the cost and the risk" of changing the position of this main, as it was necessary to do in carrying out the work.

In discussing the matter of retained percentage, Mr. Sterns says that "there is a feeling among many engineers and architects that a contract should be so worded as to force the contractor to finance himself very extensively. To this opinion the writer takes strong exception. He believes that monthly payments to the contractor should be arranged so as to compensate the contractor as far as possible for the cost of the work as it proceeds. Usually this can not be done in a simple way. In the early part of the work the contractor necessarily has a heavy investment and a relatively small amount of work performed, so that his estimates do not and can not fully compensate him. It is for this reason that his financial ability is important. After the work has progressed, however, if payments are properly arranged and if the retained percentage is not exorbitant, the time should come quickly when the payments should carry the contractor's cost. Usually the owner is in a much better position to secure the use of funds than the contractor. By compensating the contractor, fairly and reasonably, as the work progresses and reducing his necessity of obtaining loans, sometimes at quite high rates of interest, the owner establishes that feeling of good-will between himself and the contractor which is conducive not only to greater effort upon the part of the contractor to get his work done well and expeditiously, but also to cause him to reflect such feeling in his bid price."

Jacksonville Municipal Airport

Selection of site, plans, and methods of construction. Landing field data in standard form

Five years ago, the only places at or near Jacksonville, Fla., where planes could land were on the rifle range or on the beach, both somewhat hazardous. About this time local fliers established a small commercial field in West Jacksonville which has been in use for over four years. The city officials, especially Commissioner T. C. Imeson, realized that adequate landing fields would become more and more a municipal necessity and they endeavored to find a tract of land which could be purchased at reasonable cost, developed economically, combine facilities for land and water planes, and be easily accessible to the city. About three years ago the Florida Airways Corp. started air mail service in the state and it became necessary to settle the matter immediately. Some of the ideals were sacrificed and a site selected seven miles north of the post office on the Atlantic Coastal Highway and the S. A. L. Railroad, on a 640 acre tract purchased in 1912 for a city prison farm and a large portion of it still used as a stockade and city farm. While not provided with landing for water planes, the many miles of water front in the city provides unlimited facilities for this type of plane. The highway is a well paved one leading directly to the city.

The area was thickly covered with second-growth timber, mostly black oak and small pines, is sandy and slightly rolling. Three years ago last November work was started with a gang of city farm labor clearing and grubbing. One of the highway department's tractors was put on the job and pulled an average of 200 trees and stumps per day for about 60 days. Teams were hired and about 20,000 cubic yards of excavation were done in grading down small hills and filling low places. About 175 acres have been cleared to date, and some 75 or more acres planted in grass. A 6-inch artesian well with a flow of approximately 500 gallons per minute was put down.

This about exhausted available funds, but in 1925 the legislature authorized a bond issue of $100,000 for the landing field, none of which however was sold until the fall of 1927, when $50,000 worth of them were sold and work resumed on the airport. More extensive grading was done and the field now is slightly rolling with excellent natural drainage, with no slopes greater

than 1%. Approximately 75,000 cubic yards of earth has been moved a maximum distance of 600 feet, all moved with drag scrapers and mules and city farm labor at a cost of 13 to 19 cents per cubic yard.

The natural soil of more or less loose sand made a condition impossible for landing. It was figured that irrigation and methods of producing quick sod would take too much time and it was decided to build hard-surface landing strips or runways. Three were laid off, forming an approximately equilateral triangle, the east and west and the north and south ones being 2,100 feet long by 100 feet wide, while the northeast and southwest one is 2,500 feet by 100 feet. A northwest and southeast runway has been partially graded and planted with grass.

The paving of the landing strips is perhaps a somewhat original type of construction. After preparing the subgrade by grading and dragging and wetting, about 4 inches of oyster shell was spread, rolled, and approximately ⅓ of a gallon of liquid asphalt applied on the rolled shell, which first had been primed with a residual oil. This was then covered with from two to three inches of cinders and well rolled. Two landing strips were completed on Saturday October 8 and were used for the first time on Monday, October 10, 1928.

The third landing strip was completed in a somewhat different way. After it had been graded and dragged, Bermuda grass was planted, the area well watered and covered with approximately three inches of cinders well rolled into place. The grass has grown through the cinders over practically all the area and it is now an excellent landing strip. The area inside the triangle formed by the landing strips and adjacent thereto is smooth and planted in Bermuda grass and planes can land from any direction.

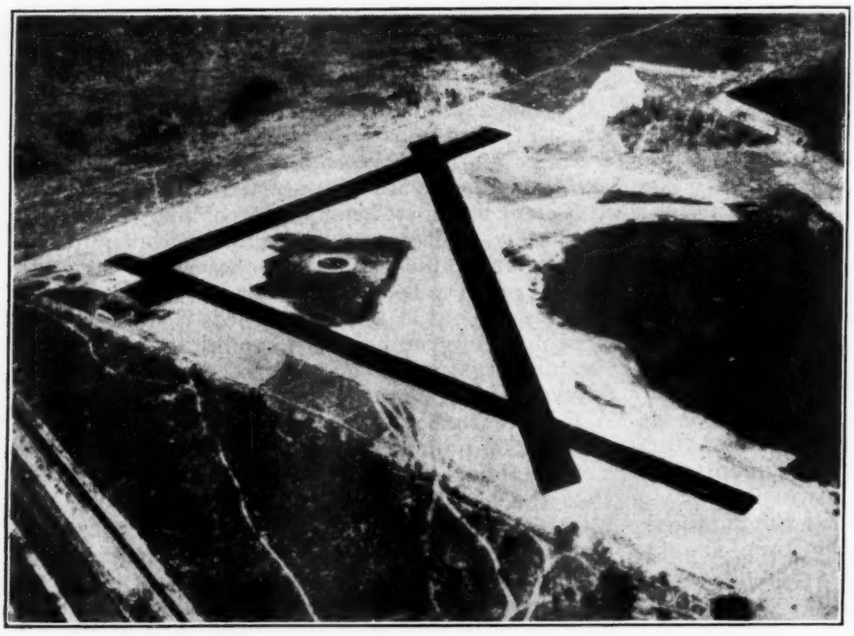
While the north and south and the east and west landing strips are hard surface for a length of 2,100 feet, they are graded to a length of 3,000 and 2,800 feet respectively.

Because the landing strips were constructed late in the season, and because the traffic would be limited, more cinders were used as covering material than would otherwise have been necessary. They are withstanding the drag of the tail skids much better than was expected and very slight damage is noted after six months of use by hundreds of landings. During December oil was applied to the loose cinders.

A 75 by 63-foot hangar has been built, with a 73 by 20-foot clear opening, constructed of heavy cypress poles set 8 feet in the ground in concrete and supporting steel bowstring trusses with wooden purlins bolted to the trusses, covered with ⅞-inch sheathing and composition roofing. The walls are galvanized iron fastened to wooden studs, with steel sash on two sides and on the back. The doors are in six panels each 13 by 20 feet, each supported on three roller-bearing flanged wheels rolling on 1-inch rails set in the concrete doorsill and having a channel iron guide with small side roller at the top. The tracks and guides extend 13 feet each side of the hangar, and three doors rest on each side having a clear full-width opening. Eight individual hangars are under construction, three of them 50 by 40 and five 40 by 40.

A small office and administration building has been built containing an office, waiting room, ladies' rest room, bedroom for night attendant or other uses, shower baths, and controls for lighting systems.

A complete lighting system for night landing has been installed which includes four 40-degree flood lights located one on the southwest corner, one on the northeast corner, and two on the northwest corner. These flood lights will be separately controlled from a switchboard in the office, the one being used over which the flyer passes in landing into the wind, so that at no time will it be necessary for him to fly into the glare of a flood light. Green lights have been installed at opposite ends of the landing strips, and white border lights, and red obstruction lights where necessary, on transmission line poles, along the road west of the field, adjacent to trees, rough ground, etc. Twenty-three hundred-volt underground distribution from one central underground cut-in is used, with transformers at four places in the field. The wiring plant is so arranged that a main switch will energize the system, turning on all border and obstruction lights which are on secondary circuits from the various transformers. The flood lights will be controlled by magnetic switches operated



LANDING FIELD AT JACKSONVILLE MUNICIPAL AIRPORT

from the office switchboard. The system is so designed that additional border or obstruction lights or additional flood lights can be installed if future development requires them, at small additional cost. A B. B. T. 1,5500-watt beacon, flashing the international code letter J, has been installed on the roof of the hangar, which is controlled by a separate switch at the office switchboard. The hangar and office building are protected by side lights on the roof reflecting on the walls. A standard wind direction cone has been installed, which will be illuminated with a small 500-watt projector, which will be so located as to light the ground area around the gasoline pumps.

The total cost of all the work to date has been approximately $68,000. For operation, the city employs a manager and the necessary help who handle the sale of gas and oil and servicing of ships.

On December 1, 1928, the Pitcairn Aviation, Inc., started operating air mail on the Atlanta-Miami line with Jacksonville as division headquarters, and office and shop space has been provided for them on the field. Heavy aviation traffic was anticipated for this winter, the average for December, including the mail planes, having been six a day, and eight privately-owned planes are located at the field permanently.

The data of the landing field, in standard form, as furnished by City Engineer W. E. Sheddan, is as follows:

Name: Jacksonville Municipal Air Port.
Class: Municipal.
Rating: .....
Owner: City.
Operator: City Commission, T. C. Imeson, Commissioner in charge.
Position: Lat. 30° 25', Long. 81° 39', Alt. above sea level 25 feet. Mag. Var. 1°, 10', 52" E. 1928. Annual decrease 2". Distance and direction from city: 7 miles north of Post Office on paved highway (Coastal Highway).
Description: Size, 3,000'x2,800'. Acres, 175. Shape, roughly triangular. Surface, sandy, sodded; gradient. rolling. Drainage, excellent. Landing strips, two 2,100'x100'; one 2,500'x100'. Entire field has been planted in grass.
Obstructions: Electric line on west; tall trees west, southwest and southeast. Hangar, west. Office and filling station, northwest. Marking: day, none; night, red boundary lights southeast and southwest; red lights on electric poles at northwest.
Markings: Standard 100' white circle in center of field. Name, "Air Port" in center of circle. Wind direction indicator, on standard, northeast corner of hangar.
Lighting: Beacon, B. B. T. Flashing beacon, flashing "J," international code. Boundary, red boundary lights on southeast and southwest; white lights east. Approach, two white lights with green light between at end of landing strips. Flood lights, at the north, east and south points of triangle; green light over east and south lights. Land over and away from flood light. Other lighting, hangars and buildings lighted.
Accommodations: Personnel for servicing, yes. Laundry fee, none. Storage rates: Hangar space, 35' or less, $1; 35' to 50', $2; over 50', $3 per day. Hangars: One 75' wide by 60' deep with 20' clearance; five small individual hangars, 40'x40'; three small individual hangars, 50'x40'. Repair facilities, yes. Spares, none. Specification fuel and oil, yes. Guard, yes. Fire apparatus, hand extinguishers. Quarters, limited. Meals, at lunch stand. Transportation to city, bus. First aid kit, yes. Mooring mast, none.
Communication and Signal Equipment: Telephone, yes. Telegraph, by 'phone. Radio, none.
Meteorological Data. Prevailing wind: Summer, southwest; Winter, northeast; annual northeast; heaviest winds usually from southwest; winds of 40 miles per hour or over are recorded, on average, 1 d. p. m. during Feb., April, July and Aug., and less frequently during other months; highest recorded velocity, 75 m. p. h. Dense fog occurs infrequently, May, Sept., incl., 1 d. p. m. during Mar., April, Oct. and Nov. and 3 d. p. m. Dec. to Feb. Light fog occurs on average 1 d. p. m. in Summer; 5 d. p. m. in Autumn; 7 d. p. m. in Winter, and 3 d. p. m. in Spring. Fogs are most frequent 5 to 10 A. M.
Precipitation as heavy as 1" or more in 24 hours averages 2 d. p. m. in Summer and 1 day or less in other seasons.
Weather map on display board, yes. Nearest weather bureau, Jacksonville, Fla. Nearest upper-air observer, Jacksonville W. B.
Remarks: Revolving beacon on building in city. "Jacksonville" painted on roof of building in city with 40' arrow pointing to field; also on west wall of building is illuminated sign, "Barnett National Bank." "Jacksonville" is also painted on smaller building in town. A large arrow is also painted on gas container 2 miles west of city pointing to Air Port.

Akron's Airport

Akron, Ohio, has a municipal airport covering 825 acres, located 5 miles from the city, with no paved runways. It now has under construction a municipal airport which will combine lighter-than-air and heavier-than-air fields located about 3½ miles southeast of the city and covering approximately 700 acres. At one end, the hangars for the Goodyear Zeppelin Corp. are being erected, in which two 6,500,000-cubic foot airplane carrying Zeppelins will be constructed. The heavier-than-air portion of the port will cover approximately one-half square mile and will be graded and under-drained. Suitable runways and hangars will be constructed here.

The contract for grading has been awarded to Cable Bros., of Canton, Ohio, and involves moving 1,300,000 yards of earth. The contractors were on the job and took out the first dipper of dirt 20 hours after they had been given the word to go ahead, notwithstanding the fact that the equipment was nearly 30 miles away at the time. They first skimmed the entire field, taking off 4 inches of top soil and piling it out of the way, to be used in covering the field after it has been graded. Power shovels, dump trucks, wagons, tractors, graders, rollers and bulldozers are used in the work. The port is to be completed January, 1930. A temporary landing field on the port is now being used by the Continental Air Lines flying between Cleveland and Louisville.

B. E. Fulton is manager of the airport, and the construction is under the direction of Fred E. Swineford, director of public service of Akron.

Wichita Airport

A few years ago a group of public-spirited citizens of Wichita, Kans., developed an airport, erected hangars, and lighted the field for both day and night flying and furnished facilities for N. A. T., incidentally selling about ten acres to an air craft manufacturing company. The city later purchased the equipment and reimbursed the boosters for incidental expenses, taking a lease on the land for about two years, or until such time as a larger airport could be developed. The present airport contains 149 acres which, because of its temporary character, has not been given a Department of Commerce classification, nor have runways been developed, but planes use the native prairie sod, which has proven satisfactory under all weather conditions.

The city immediately took steps to purchase a solid section of land six miles from the city, which has never been under the plow, which has perfect drainage, is accessible to paved highways leading to the city, and which has possible runways three and four thousand feet long in all of the major directions; the price being $100 an acre, the $64,000 being obtained by bond issue not requiring an election.

The plans for the new port as developed will give it an A-1-A rating and the city commission has definitely arranged to issue bonds as fast as necessary to build passenger terminals, public hangars, necessary utility buildings, excellent lighting facilities and some runways adjacent to

the hangars and passenger stations. Bids are now being received for the first units of the public hangars.

The development, maintenance and operation of the field is vested in the Board of Park Commissioners of the city, largely because they have authority to issue up to $150,000 per year without referendum, park improvement bonds including airports.

As tentatively laid out, the field will include two north and south runways, one east and west runway, one northeast and southwest, and one northwest and southeast.

In Wichita there are located six aircraft factories, one airplane motor factory, seven air transportation companies, and eleven schools of aviation and aeronautics.

Wausau's Airport

Wausau, Wis., has an airport of 95 acres, 2¼ miles from the city, which cost about $30,000 and was obtained by means of private funds, being owned by the Wausau Airport Corp. The entire area is sodded and can be used for landing, giving a 2,500-foot length of runway.

About two miles west of the airport is Rib Mountain, elevation, 1,955 feet, which is said to be the highest land between Lake Superior and the Gulf of Mexico. On this a powerful electric light beacon is to be located, which will be visible for a radius of 400 miles in all directions.

Ten licensed air pilots live in Wausau, the most noted being Major John P. Wood, who won the National Reliability Tour last July.

Other Airports

Berwick, Pa., has two landing fields, one a rectangular field about 1,000 feet long with no obstructions on east, west or south, and with a gravel surface. The other has an area of about 35 acres and is about 2,500 feet north and south with a westerly extension 600 feet wide extending 1,900 feet from the main portion. The only obstructions are a grove and some houses south of this extension.

The Altoona, Pa., Aircraft Corp. occupies Stultz field, which is three miles from Tyrone and eleven miles from Altoona and directly on Pennsylvania state highway, Route 220, and on the Pennsylvania R. R. It is approximately rectangular in shape, 2,144 feet long, and 955 feet wide at one end and 1,240 feet at the other end. It has a hangar with a beacon flash and a rolled landing strip in the direction of the prevailing wind.

Six miles in a direct line from Hazelton, Pa. (probably eight or nine miles by road), is Veale Airport. This is about 1,040 feet wide by 1,250 feet long. It is on high ground, entirely surrounded by open cultivated fields, and there are no obstacles except an orchard and house in the northeast corner, where also is located the hangar.

At South Boston, Va. is an airport known as New York-Atlanta Airport No. 36, about one mile in a direct line from the city, but over four miles by road. This airport is located on the Dan river. It has a northwest and southeast runway of 2,800 feet and northeast and southwest runway of 2,200 feet. The runways are sodded. The lights are field, boundary, obstruction and a 75-foot beacon. There are day and night caretakers.

The city of Birmingham, Ala., has leased Roberts Flying Field, the property of the Republic Iron and Steel Co., and operates it as a municipal field. It is approximately 2,000 feet long east and west and 2,000 feet wide at one end and 1,400 feet at the other end. On the north runs a railroad and a line of willows and cottonwoods from 25 to 50 feet high; on the west is Village creek; on the south is a line of telephone poles. At the southeast corner are hangars, a parking area, gas station, etc., and on the east a clubhouse, stables, etc. A revolving beacon on a 65-foot steel tower is located at the clubhouse about 500 feet east of the field. The field is surrounded with border lights on underground cable and obstruction lights along the telephone pole line.

Kearney, Nebr., has an aviation field in the form of an "L," the north and south branch of which is about 2,280 feet long and 814 feet wide, while the west branch extends from this 1,795 feet to the west with an average width of about 1,500 feet. The landing strips run north and south, east and west, northeast and southwest, and northwest and southeast.

At Ponca City, Okla., is the Everett Taylor Airport, two miles by excellent paved highway from the southwest corner of the city. Just east of it across the highway is a tank farm containing 84 oil tanks; south of it are some houses and north of the northeast corner is a cemetery. It is 2,600 feet long north and south and about 1,200 feet east and west. It has a northwest and southeast runway 2,200 feet long and a northeast and southwest runway 1,500 feet long, intersecting at a circular runway marker. There are green lights at the ends of both runways. In the northeast corner is a hangar and immediately south of it is a revolving beacon and another hangar. The entire field is surrounded with boundary lights.

Deming, N. M., has an airport not yet completed, which is five-tenths of a mile east and west by 600 feet wide, from which extends in a northwesterly direction a branch about three-tenths of a mile long and an average of about 350 feet wide.

At Flagstaff, Ariz., is Koch field, eight miles from the city by U. S. Highway No. 66. To the west lie mountains rising 2,500 to 6,500 feet above the field, and other lower mountains to the north and hills to the south. Immediately surrounding the field, however, are farm lands with barns, pine timber, etc. This is owned and operated by the city of Flagstaff. It is one mile square, with surface of cinders and gravel and very light gradient. There are four runways 300 feet wide, with lengths of 6,600 feet, 6,200 feet, 5,200 feet, and 5,200 feet respectively, leveled smooth. No lighting installation has yet been made. There is a wind direction indicator

on the administration building. The field never gets muddy, the soil being of volcanic material.

Cisco, Texas, has an airport under construction adjacent to Randolph College. The landing strips are 500 feet wide, an east and west one 2,750 feet long, a north and south one 1,800 feet long, northeast and southwest one about 2,500 feet long, and a northwest and southeast one about 2,200 feet long.

San Antonio, Texas, has a municipal airport known as Winburn field, six miles south of the city by paved road. It is entirely surrounded by fields and brush. Hangars and beacon lights are on the northeast side adjacent to the paved road. Three runways are graveled, 100 feet wide, and extend north and south 2,500 feet, east and west 2,500 feet and northwest and southeast 2,500 feet. The field is entirely surrounded with boundary lights and there is a standard circular runway marker at the interesection of the three runways.

Boise, Idaho, has a municipal airport on the Boise river, connected with the business center of the city by a paved street. It is entirely surrounded with boundary lights, has green approach lights at each end of the one runway, which is laid out in the direction of the prevailing wind; has red obstruction lights at the bridge across the river and at a few other points; has flood lights at the southeast corner flooding the runway; has a rotating beacon and wind cone, and several hangars.

Long Beach, Calif., has maintained a municipal airport since 1921. It is situated 4½ miles from the business district and about three miles from the coast, and is served by the Union Pacific Railroad and state highways along the sides. Three hundred and fifty-six acres are available, with a slight slope affording natural drainage, and entirely graded, leveled and rolled, so that airplanes can land anywhere in any direction, giving runway lengths of 6,190 feet in one direction and 2,900 feet in the other. It has an eight million-candlepower revolving beacon light visible 20 to 50 miles, and hangars, buildings and landing areas are fully illuminated by flood light. There is ample space for parking, hangars, repair shops and aircraft manufacturers.

Contract Practices in Five Hundred Cities

Information furnished by city engineers concerning the amount of paving work done by force account; the furnishing of contract bonds and bidding surety; requiring contractors to qualify; amount of percentage retained; and requiring guarantees of pavements

City engineers throughout the country recently were requested by PUBLIC WORKS to answer questions concerning certain practices in the performance of public works, in their respective cities. When about 500 replies had been received (others are still continuing to come in) preliminary analysis of them was made, and the results are given in the following paragraphs.

WORK BY FORCE ACCOUNT

One of the questions asked was how much pavement construction was being done by the city by force account and how much by contract. Of 472 replies from 44 states, 384 reported that they did no street paving by day labor, but all by contract. On the other hand, 49 of the cities reported doing all of their paving work by day labor, and none by contract; while 36 did some in one way and some in the other. Three reported that they did repair work only by day labor, and it is quite possible that the same applies to others of those reporting doing some of their work in each way.

In Astoria, Ore., the Commission, if not satisfied with the bids or bidders, may throw out all bids and do the work by force account; but in such case the final cost must be within the estimate of cost as made by the engineer previous to calling for bids. Astoria owns and operates an asphalt plant, and furnishes and lays all the asphalt wearing surface constructed in the city, furnishing a price to contractors which they include in their bid.

Classifying by states, the percentage of reporting cities in each state which performed none of their highway construction work by day labor was as follows: Alabama 75%; Arizona 30%; Arkansas 100%; California 80%; Colorado 80%; Connecticut 50%; Florida 40%; Georgia 75%; Idaho 30%; Illinois 75%; Indiana 100%; Iowa 100%; Kansas 100%; Kentucky 95%; Louisiana 100%; Maine, none; Maryland 100%; Massachusetts 25%; Michigan 60%; Minnesota 90%; Mississippi 50%; Missouri 90%; Montana 100%; Nebraska 100%; New Hampshire, none; New Jersey 90%; New Mexico, 100%; New York 90%; North Carolina 80%; North Dakota 100%; Ohio 95%; Oklahoma 95%; Oregon 40%; Pennsylvania 93%; South Carolina 100%; South Dakota 100%; Tennessee 100%; Texas 80%; Utah 30%; Virginia 20%; Vermont, none; Washington 100%; West Virginia 30%; Wisconsin 80%; Wyoming 100%.

BID SURETY

Practices vary considerably concerning the check or bond required to accompany bids to insure that the bidder to whom the contract is awarded will sign the same. The amounts required vary in the different cities from 1% to 50% (or even 100% reported in some cases, unless the question was misunderstood). In some cases the amount is a percentage of the total of the bid, some varying this with the size of the contract; in others it is a stated amount. The stated amounts vary from $50 to $10,000. Of the percentages, 5 is the most common, fifty percent of those replying giving this percentage. Thirty-seven percent reported 10% of the contract

price, while the other percentages reported, in the order of popularity, were 2½%, 2%, 3%, 33⅓%, 15%, 12% and 1%.

CONTRACT BONDS

The size of contract bond required also varies widely in the different cities, the practices grouping themselves largely by states. The amount varies from 5% of the total bid price to 200% of same. In some of the states the amount of bond required is regulated by the state law. In Georgia 100% is required, and the same is required by the Iowa law. One West Virginia city reports that it does not bond contractors if they are local firms and known to the officials.

In a number of the states two or more bonds are required serving different purposes. For instance, in California 50% of the bid price is required for maintenance and labor and 25% for the performance of the contract. In Kansas 100% is required for performance of contract and 50% for liability; and in Michigan, Missouri and some other states, 100% for construction bond and 50% for maintenance bond. Some of the Texas cities require 50% for construction bonds and 35% for maintenance bond; while one Texas city requires 30% for construction and 20% for maintenance.

The amount of bond required is the total amount bid by the contractor in 50% of the cities. The next most common amount is 50% of the bid price, which is the practice in 30% of the cities. Other percentages of bid price, in their order of use, are 33%, 75%, 25%, 200%, 60%, 40%, 65%, 20%, 5%, 150%, 10%.

QUALIFICATION OF CONTRACTORS

One of the questions asked was: "Do you require contractors to qualify, before awarding the contract, as to experience, capital, equipment, and reputation?" Of the 388 replying to this question, 65% replied that they required contractors to qualify in respect to all these items. If we assume that those that did not reply to this particular question did not require contractors to qualify, we find that just about 50% of the total number do so require. Sixteen percent of those replying do not require contractors to qualify in any of these points. Three hundred and eleven reported requiring a qualification as to experience, 303 as to reputation, 285 as to equipment, and 275 as to capital. In the majority of cases the cities do not require contractors to pre-quality, but examine the qualifications of the lowest one or more bidders. In Iowa the courts have decided that the "submitting of a bid check is proof of responsibility." In a number of states the state law requires contracts to be awarded by cities to the lowest responsible bidder. A number of cities make it a practice always to award contracts to the lowest bidder or else to readvertise; generally, we believe, because the officials do not wish to subject themselves to the criticism which would be raised if they awarded the contract to any except the lowest bidder. Only about 30%, however, state that it is their practice always to award to the lowest bidder, although about an equal number state that they do so if the lowest bidder is "reputable," "responsible," "satisfactory," etc. About 30% state that they do not always award contracts to the lowest bidder, but they probably come under the second class, those which do so award the contract if the lowest bidder is satisfactory; otherwise there would seem to be no object in advertising for bids.

RETAINED PERCENTAGE

The question was asked: "How much of the monthly estimate do you retain?" It developed from the answers that in possibly the majority of cities, no monthly estimates are given in paving work and no payment made until the work is completed and accepted. Under the street improvement law of California, the entire cost of a street improvement is to be assessed on the property in the improvement district and paid for on completion and acceptance of the work by a warrant empowering the contractor to collect the several amounts assessed against the various lots of the land in the district, which are valid liens against the property. The Barrett Law of Indianapolis is similar to this. Several cities report that the work is usually completed in two or three months and it is not thought worth while to make monthly estimates, but payment is made when the job is completed. Where part of the payment is made by property owners and part by the city at large, it is more or less common practice for the latter to be paid monthly with 10% to 20% retained, while the former is, as stated, paid only after the completion of the work.

Where and when percentages of monthly estimates are retained, these vary from 1% to 40% in the different cities. Forty-one percent of the cities report retaining 15%, while thirty-eight percent retain 10%. Sixteen percent of the cities retain 20%, while the remaining five percent of the cities retain amounts of 25%, 5%, 35%, 1% and 40%. These percentages are subject to variation in a number of cities. For instance, Santa Cruz, Calif., retains 25% on labor and 15% on material. Several cities report retaining 15% during the work until completion and 5% for a number of months or years after completion and acceptance. One New York city retains 15% until the amount reaches $10,000, after which no additional amount is retained. One Ohio city retains 10% on asphalt, 5% on concrete and brick. One Pennsylvania city retains 20% on brick, 10% on concrete. Another city pays one third of the contract price when the work is half done, another third when the work is completed, and the remaining third four months after completion. One Michigan city which retains 10%, makes semi-monthly estimates and payments.

GUARANTEE BONDS

It seems to have been the almost universal practice years ago, especially in the case of asphalt pavements (concerning the construction of which little was then known outside of the companies laying same) to require a guarantee of the pavement for a number of years varying from 5 to 15 or 20, covered by guarantee bond given by the contractor. While this practice is now by no means universal, a considerable percentage of the cities still adhere to it. Other cities require a bond covering maintenance of the pavement

for a given number of years, but no such guarantee can be required in California or Washington, by state law. On the other hand, the Iowa law requires cities to obtain at least a four year's guarantee from the contractor.

The term of the guarantee required by the different cities varies from 2 months to 15 years, but where no special kind of paving is specified, 57% of them require a 5-year guarantee, and the average of all of the guarantee periods is 3.2 years. In a considerable number of cities the guarantee period differs with the different kind of pavement. In those cities, 5 years is the common period for asphaltic pavement, this being required by 82% of the cities, while the maximum is 15 years and the average of all the periods is 5.1 years. In the case of concrete, the period varies from nothing (in several cases where a guarantee is required of asphalt pavement) up to five years, the average of all the periods being 2.1 years. In the case of brick, this also is free of guarantee in some cities where a guarantee is required for asphalt pavement; 5 years is the maximum, and the average of all of the guarantee periods is 1.7 years. One Texas city requires 4 years where the pavement is laid on a 4-inch concrete base and five years when on a thicker concrete base.

Recent Practice on Eastern Highways

Abstracts of some of the papers before the Fifth Annual Convention of the Highway Officials of the North Atlantic States. Others will be given in the next issue

GUARD FENCES

Trend of highway guard fence design was discussed by H. F. Mattimore, engineer of tests and materials investigation, Pennsylvania Department of Highways, and by F. P. Woodruff, assistant superintendent of maintenance, New Jersey State Highway Department. Mr. Mattimore described briefly experiments with guard fences carried on by the Pennsylvania State Highway Department during the past four years, in which 100 feet of guard fence was subjected to impact of a loaded five-ton truck (ten-ton gross load) and an average-weight automobile striking the fence at varying angles and speeds. Since 1924 tests have been run only with wire rope fastened to wooden posts.

These tests indicated that: 1—Rigid rails or stone walls may prove more of a hazard than a safety factor. 2—Provision must be made, at least on primary routes, to hold heavy vehicles under normal speed, with consideration for heavy buses at very high speed. 3—To minimize the danger of the occupant and the damage of the vehicle, the guard fence should have some resiliency and not be an absolutely rigid type. 4—Offsetting the rope four inches from the post is a safety provision in preventing hubs of most vehicles from hitting the post, which might throw the vehicle out of control and possibly damage the post.

The present standard in Pennsylvania is a guard fence with two wire ropes offset four inches from the post line, generally with a one-inch top rope and a ¾-inch bottom rope.

Mr. Woodruff expressed as his opinion that the guard fence is to serve as a warning rather than a device to prevent vehicles from leaving the road. However, in at least one state the law requires the highway department, under penalty of liability for damages, to provide adequate protection; while in another state, where the highway act charges the highway department to keep the highways "smooth and hard," the courts have held a county liable for all damages sustained by a motor bus breaking through a section of guard rail and running down an embankment.

In 1928, in New Jersey, the dead-man anchorage at the ends was replaced with two six-inch wooden struts between the last two posts, one between the upper and lower cable, and the other between the lower cable and the surface of the road, forming a rigid end panel, which was further strengthened by twelve strands of wire passing from the end posts at the surface of the ground to near the top of the second post and twisted until taut. The two end posts were set in concrete. Extensive use is made of the "washboard," a one-inch by twelve-inch creosoted timber embedded six inches in the ground and nailed to the guard rail post, tending to prevent washouts in the fills which would reduce the stability of the guard rail post.

In 1929 New Jersey is adopting the offset type of guard rail, somewhat similar to the Pennsylvania type. The cable will be held by means of a "J" bolt which passes through a spool-shaped offset casting and through the post to a plate washer and nut. All posts will be square, which will permit better seating of the offset casting, involves little or no increased cost, and the post will take a much better wood preservative treatment. They will be painted black from the surface of the ground to the bottom cable and then white to the top. He believes this construction with two ¾-inch cables will be sufficient for tangents, and easy curves and grades, where the fill is not excessive. Where fills are high, curves sharp, or grades steep, greater rigidity is desirable, obtained by increasing the sectional area of the posts, reducing the panel length, increasing the diameter of the top cable or both cables, imbedding additional posts in concrete, and using longer posts set further into the ground. He

doubted whether guard rails of any kind or even stone walls would offer complete protection to speed demons, sleeping drivers, or overloaded or top-heavy vehicles.

PAVEMENT MARKING AND TRAFFIC CONTROL.

In a paper with this title, W. H. Sharp, engineer of repairs, Connecticut State Highway Department, confined his attention to intercity state highways, discussing pavement traffic lines, and traffic control by warning signs, illuminated signs, directional signs, and automatic signals; and rerouting traffic.

Traffic lines, he said, should be placed only on curves where the sight line is less than 500 feet and on hills where approaching traffic cannot be seen. Such lines should be extended far enough on the tangent each side of the curve or crest of the hill that traffic will have opportunity to observe the line before reaching the point of danger. Continuous traffic lines, he considers, defeat the purpose and effect of the line. On curves, the line should not necessarily be placed in the middle of the road, but the location should vary with the degree of curvature, as the traffic which follows the outside of the curve needs more pavement room to negotiate the curve. There is considerable discussion as to the advisability of placing traffic lines where there is more than two-lane capacity. The traffic lines should be six inches wide, of white paint.

In discussing the other headings, the author quotes extensively from the 1927 report on standardization of signs by the Association of State Highway Officials. If a warning sign requires immediate obedience, it should be placed where the obedience is to be given; while one requiring caution at some future place should be so located as to give proper warning.

In the matter of illuminated signs, he believes that red should be used only where an absolute stop is necessary, and that the warning signs should be of amber. Connecticut, at extremely short curves or decided change of line of the road, uses the yellow sign with a plain black arrow in which is incorporated the illuminating lens of amber. This not only warns the motorist, but the arrow tells him the direction in which the highway turns.

Not more than three directional signs should be placed on any one post, as more is confusing and causes delays of traffic to permit occasional motorists to read them. He believes that in intercity highways automatic signals should be used only in very extreme cases, but he would substitute for these, at danger points, the boulevard system. Serious problems for traffic control include obstructions such as pedestals for blinker signals, extremely sharp curves, bottle necks, sight lines at intersecting roads, and slow drivers.

The advantages of rerouting traffic around cities he gives in a quotation from the report of the Highway Research Board, concluding with the sentence: "The loss of time and inconvenience caused to through traffic by its necessary passing through congested areas far exceeds any local convenience or benefit."

SURFACE REPAIRS AND SURFACE TREATMENT OF ASPHALTIC AND TAR PENETRATION SURFACES.

In a paper with this title, George E. Hamlin, superintendent of maintenance, Connecticut State Highway Department, said that failures in such surfaces are due to use of haphazard methods and materials. For the first two or three years a well constructed bituminous surface carrying sufficient traffic requires only isolated surface maintenance. Travel is important for developing the maximum value of such a surface by compacting it and producing a kneading action. Where this does not occur, local treatment to seal the surface and prevent water absorption may be necessary. This treatment may be given by pouring heated bitumen with handpots and brooming it in, followed by an application of clean, coarse sand, broomed in while the bitumen is warm. If a large section is to be treated, a pressure distributor may be used. Two or three light applications of both bitumen and sand are preferable to one heavy one; each application to be honed until bitumen and sand are uniformly incorporated and surface voids filled. All voids should be filled, by additional applications if necessary.

If there is bleeding, this is best controlled by applying tar as on ordinary macadam surface. In Connecticut, adding stone chips to a bleeding surface has resulted in a rough, irregular surface, and a recurrence of bleeding in places due to unequal quantities of bitumen.

For surface patching, premixed material has proven unsatisfactory in Connecticut, forming a surface skin that can not be honed satisfactorily.

For serious disintegration, best results are obtained by cutting out to the full depth of the surface all of such areas as lack the original strength, and reconstructing to conform to the original specifications, using the same grade of clean stone and the same amount of bitumen per square yard, uniformly distributed, in two applications. The patch can be hand-tamped around the edges, and much of the necessary compacting can be obtained by utilizing the wheel of the maintenance truck, first sprinkling a thin layer of ¾" stone to prevent picking up. The seal coat is best deferred until the patch has been compacted by traffic.

A surface break generally means unsatisfactory material to the full depth of the pavement, including insufficient bitumen; consequently surface repair with premixed material is generally unsatisfactory.

Surface treatment is intended not alone to renew the surface but also to restore the lighter oils lost from the original bitumen content, and thereby reduce cracking and checking. Only frequent examinations, including opening the pavement to its full depths, will determine when surface treatment will be necessary. It is better to anticipate the time of necessity than to defer treatment beyond it.

In surface treatment, a "cold application surface tar," heated to 135° F., is sprayed under pressure at a rate between 0.1 and 0.25 gallon per square yard, varying with the surface condition, and just enough sand applied to blot the bitumen. Within eighteen hours the surface is dragged, from edges to center and then from center to edges, excess material being deposited on the shoulders; using a hone of heavy oak with three cutting edges, or a road plane if extreme cutting action is desired.

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A Question of Stream Pollution

Should a company or community, in the development of a water supply, construct a dam which backs up the water and raises the elevation of same in the tail race of a water power plant further up stream, the owners of this plant would ordinarily be able to collect damages from the community or company for the diminution of their power caused by such raising of the tail race elevation. If this plant should discharge into the stream phenol substances or other materials which would increase the cost of operation of the purification plant necessary for producing from this water a safe and palatable public supply, should not the community or water company, in turn, be able to collect damages from the company to equitably offset such increased cost?

This question is suggested by the paper by Wellington Donaldson, an abstract of which is published elsewhere in this issue. Mr. Donaldson shows how increased hardness may cause an increased cost to the community, either for softening the water supply or because of additional use of soap necessary and its effect upon boilers, hot water heats, etc.; and other substances may necessitate an increased dosage of chlorine or of coagulants, or increased filter area, again at an increased cost which must be borne by the consumers, the taxpayers, or the water company. Should not the polluting company be required to either prevent the pollution or, as an alternative, compensate the city for the additional cost?

Trends in City Paving

For about twenty years PUBLIC WORKS has been gathering paving data such as are presented in this issue. The accumulated information so collected forms a valuable record of paving progress, and a review of it accentuates the changes that have taken place since 1910. In those days macadam was the material commonly used for the average city streets, although in the larger cities sheet asphalt and brick were being laid on the main thoroughfares and granite block for heavy traffic. Automobiles were coming into use, but paving design was still based upon steel-tired traffic.

As the hundreds of questionnaires which have been returned to this office during the past six weeks have been inspected and the data tabulated so as to make it most convenient for use by our readers, we have been impressed with the changed conditions. Brick and sheet asphalt pavements maintain their place in the favor of city engineers but no longer have the field to themselves. Bitumens are used in many forms other than sheet asphalt, and especially noticeable is the advent of concrete in the street paving field; while macadam and gravel, unsuited for the wear and tear of present-day traffic in busy streets, are no longer being built in cities in any considerable quantities.

Pavements are being built not only in larger quantities but better than ever before, we believe; and more cheaply if considered in terms of service rendered per dollar of cost. The industry, art and science of paving have advanced marvelously in two decades.

Who Should Assume Risks in Contracting?

On another page of this issue we present the more or less contrary ideas of two engineers, with an experience making them competent to speak with authority upon the subject, relative to the justice or advisability of requiring contractors to assume most or all of the risks involved in carrying on construction work.

A generation ago it was quite generally assumed that a contractor was naturally a gambler and that he should assume all risks of any kind whatsoever, agreeing to take conditions as he found them and produce a finished piece of work for a predetermined sum. Recently there has been a gradual and quite considerable change in this idea and it is recognized that, while the contractor must assume some risk, as must any business man, work will be undertaken by a more desirable class of contractors and money will in the long run be saved to the owners if the latter will assume some of the risk. Where the work involves unknown conditions to an unusual extent, it is even becoming more or less common practice for the owner to assume all the risk and pay the contractor on the cost plus basis.

It seems to us that a thoughtful inspection of the problem will indicate that here are two different classes of risks, one of which is naturally attached to the work of the contractor, while the other would more logically be assumed by the owner. The contractor carries on his work under certain conditions for which he is immediately and directly responsible and which he himself can control insofar as they are controllable, while the owner has no control over them. Such are those involved in the operations of his plant and of his workmen, and risks of loss through falling scaffolding or strikes, for example, would seem to be his to bear. On the other hand, the owner furnishes to the contractor the ground upon which or in which the construction work is carried on, and it would seem logical that he should hold himself responsible for conditions found therein. He certainly has much better opportunity and a longer time in which to acquaint himself with these conditions than bidding contractors would have. For example, in the case of proposed underground work where the kind, location and amount of rock which will be encountered is an important consideration, it cannot be expected that each of the several contractors who may wish to bid upon the work will make a complete investigation of the site by borings, while the owner would logically be expected to do so in connection with the preparation of the plans; therefore it would seem that it should be the owner rather than the contractor who should assume responsibility for increase in cost or other risks caused by unforeseen underground conditions.

In many and perhaps a majority of cases the owner does assume such responsibility; he is doing so when he provides that a contractor for trench work shall be paid an additional sum for any rock he may encounter or be compensated, on a cost plus basis or otherwise, for such handling of ground water as may be necessary in the prosecution of the work.

Responsibility for accidents or delays due to what are commonly known as "acts of God," such as floods, tornadoes, etc., might equitably, we think, be divided between the two, and an approximation to this is more or less common practice. For instance, a contractor who agrees to complete a job by a given day under foreiture of daily liquidated damages, usually has the time extended for the number of days by which the work has been delayed by such natural phenomena, although the owner may suffer loss by such delay; and the same concession is frequently made to allow for strikes, although these are something for which the contractor rather than the owner would seem to be more or less directly responsible.

Kentucky Highway Time Limit Policy

On November 28, 1928, the State Highway Commission of Kentucky adopted a new policy relative to liquidated damages for delay in completing road work. The new paragraph of the standard specification relating to the subject says:

As the prosecution of work in connection with construction of road and bridge projects will incommode the public, obstruct traffic, and interfere with business, it is important that such work be pressed vigorously to completion. Also the cost to the department for the administration of the contract, including inspection, engineering, supervision, and maintaining detour, will be increased or decreased as the time occupied in the work is lengthened or shortened. Therefore, on each advertisement, proposal and contract for contemplated improvements will be stated a certain definite sum, the amount of which will be determined by the State Highway Commission, for each such improvement; said sum to become a daily "Liquidated Damage" in event the project should not be completed in the time specified.

The contractor in submitting his proposal will state the number of working days within which he will complete the proposed improvement. In determining who is the low bidder, the total amount of any bid will be ascertained by adding the sum derived from multiplying the number of working days, herein set out, by the said "Daily Liquidated Damage," to the total amount of the regular bid items. Should the contractor fail to complete the work within the number of working days set out in his proposal and contract, there will be deducted by the Commission either from his current or final estimate the amount determined by multiplying the daily "Liquidated Damage" by the number of working days required by the contractor to complete his work after the date of completion has been reached. The contract amount will be the sum total derived from extending each separate bid item by the unit bid price, exclusive of the said "Liquidated Damage" item.

Any adjusted date of completion will be determined by the Highway Commission from records kept by the Engineer, which records shall show the number and date of all working days which have elapsed after official notice by registered mail has been given to begin work. The Highway Commission will allow such credit as, in its judgment, may be deemed equitable and just in arriving at any adjusted date of completion for any and all working day delays occasioned by any act or failure to act on its part. Additional working day credit will also be allowed the contractor to cover any time required to complete approved over-runs or additions to his contract in the same proportion that the said over-run or addition in monetary value bears to the original contract amount.

In recording the working days on any contract, the Engineer will base his reports on whether or not the contractor could have used his necessary organization and equipment in productive work for any portion of a ten-hour day in excess of five hours; or whether or not he could have so used more than fifty per cent of his

necessary organization and equipment for the entire day. "Productive Work" shall mean the production of items, for which the contractor receives direct remuneration. "Necessary equipment and organization," shall mean that equipment and organization which in the opinion of the State Highway Engineer is essential at any time for the completion of the work within the specified number of working days.

The amount of "Liquidated Damages," as described herein shall in no event be considered as a penalty, nor otherwise than as an agreed "Liquidated and Adjusted Damage."

The commission will fix the daily liquidated damage for each contract, having set from $45 to $65 for the several contracts bid on at the January 31 letting.

In commenting upon this "The Scraper," the organ of the Kentucky Contractors' Association says: "The degree of satisfaction with which this plan will operate will undoubtedly be proportional to the rigidness with which the overtime is charged against the contractor. It is our recommendation that every bidder estimate conservatively the time which he requires on each project, believing that he will be compelled to pay the prescribed daily rate for additional time. We would also advise any contractor working under these new conditions to have an understanding with his resident engineer at the close of each day concerning the status of that day as regards elapsed time."

Street Pavement Laid During 1928

Figures furnished by city engineers of six hundred cities, giving area of each kind of pavement laid and average cost of same

Sheet Asphalt

State and City	Area laid in 1928, sq. yds.	Cost per sq. yd. surface & base
Alabama:		
Birmingham	100,156	$2.16A
California:		
Vallejo	2,000	R
Connecticut:		
Meriden	4,500	3.20
New Britain	2,000	1.25Rs
New Haven	155,745	2.35B
Florida:		
Jacksonville	65,960	3.28B
Miami	51,553	2.30B
Georgia:		
Savannah	2,162	2.33
Illinois:		
East St. Louis	9,298	2.53B
Evanston	8,982	3.98
Geneva	70,000	2.49B
Joliet	2,200	2.10S
Indiana:		
Fort Wayne	2.08 mi.	113,803C
Frankfort	18,000	1.95SC
Gary	84,462	1.73SC
La Porte	7,742	2.36
Va'paraiso	30,000	1.75S
Iowa:		
Council Bluffs	5,395	2.49C
Oskaloosa	46,000	1.18
Kansas:		
Leavenworth	35,698	1.05Rs
Parsons	15,025	1.48Bs
Massachusetts:		
Fall River	155,783	2.28-3.75
Milton	12,500	1.30S
Peabody	28,000	1.35-1.50
Pittsfield	3,600	3.75DX
Winchester	67,469	1.40S
Michigan:		
Ann Arbor	35,451	2.80
Flint	294,771	.98-1.21B
Halfway	3,500	3.10E
Highland Park	10,727	2.87F
Holland	59 227	2.02-2.39B
Kalamazoo	56,618	2.10C
Muskegon	42,030	.90-1.15C
Port Huron	21,310	.99-1.06
Mississippi:		
Jackson	47,283	2.45-2.65
Nebraska:		
Lincoln	3,997	2.39
Omaha	7,938	2.21B
New Jersey:		
Bayonne	72,894	3.00
Camden	64,417	4.12T
Collingswood	80,000	1.60G
Englewood	25,568	3.69
Garfield	1,900	2.50
Jersey City	77,605	2.00E
New Brunswick	53,926	3.10-4.15
Passaic	31,000	4.00
Plainfield	7,000	4.00
New York:		
Niagara Falls	28,192	4.44
Syracuse	341,487	2.80
North Carolina:		
Gastonia	30,000	1.77
Greensboro	20,963	1.96
Ohio:		
Akron	112,518	2.84B
Alliance	20,204	3.15
Ashtabula	28,129	3.22
Columbus	231,532	2.56BF
Cuyahoga Falls	50,000	1.45
East Palestine	19,302	2.35
Elyria	7,600	2.32RsC
Fostoria	13,000	1.80Rs
Girard	4,094	1.25SC
Kent	7,091	2.80
Lakewood	16,463	2.81B
Lancaster	20,023	2.57
Mansfield	30,000	2.80
Marion	4,400	1.96RsB
Massillon	34,500	2.65B
Newark	40,668	2.35G
Salem	27,642	1.63
Shelby	4,635	2.94
Warren	18,683	1.26S
Youngstown	41,771	...
Pennsylvania:		
Carbondale	8,000	2.00S
Donora	8,644	1.95
Harrisburg	28,000	3.50BX
Lancaster	1,600	3.75C
Scranton	28,105	4.20B
Sharon	9,933	2.78C
Wilkes-Barre	37,000	4.65T
Texas:		
Fort Worth	37,334	2.50
Virginia:		
Lynchburg	795	0.55S
Wisconsin:		
Green Bay	100,000	2.24
Kenosha	92,643	2.02B
Oshkosh	18,679	1.60S-3.32X

Notes: A—Surface 1½ in., binder 1 in.; B—Surface 1½ in., binder 1½ in.; C—Surface 1 in., binder 1½ in.; D—Surface 2 in., binder 1 in.; E—Surface 2 in., binder 1½ in.; F—Surface 1½ in., binder 2 in.; G—Surface 1 in., binder 1 in.; R—Repairs only; Rs—Resurfacing; S—Surface only; T—Includes other items; X—Includes excavation or grading.

Ashphalt Concrete

State and City	Sq. yds. laid in 1928	Cost per sq. yd. surface and base
Alabama:		
Birmingham	219,081	$2.22
California:		
Alameda	19,600	2.25
Berkeley	69,670	2.03
Fullerton	76,460	1.44-1.67
Long Beach	18,000	...
Ontario	55,555	1.35
Oxnard	3,600	...
Richmond	9,343	2.95
Riverside	21,524	1.40-1.44
San Diego	51,080	1.31
San Rafael	35,572	3.22
Santa Ana	1.27 mi.	...
South Pasadena	27,700	1.35
California (Continued)		
Stockton	35,384	1.49
Vallejo	2,650	.90-2.07
Colorado:		
Colorado Springs	27,178	1.65
Greeley	20,489	1.49
Connecticut:		
New Haven	4,975	.90
Florida:		
Jacksonville	22,452	3.94T
Georgia:		
Brunswick	45,000	1.63
Illinois:		
East St. Louis	3,455	2.08
Mt. Vernon	11,000	1.60
Indiana:		
Anderson	29,782	...
Fort Wayne	4.36 mi.	296,351T
Muncie	40,291	1.88
Iowa:		
Davenport	45,390	1.47Rs-2.42
Kansas:		
Leavenworth	24,104	1.88
Topeka	34,500	...
Wichita	24,355	2.35
Kentucky:		
Fort Thomas	4,580	1.88
Maine:		
Westbrook	8,500T	2.20
Massachusetts:		
Fall River	12,280	1.74
Haverhill	13,029	1.57
Mississippi:		
Hattiesburg	19,000	1.75
Jackson	103,000	1.91
Missouri:		
Independence	6,416	1.42
Joplin	7,600	1.63
St. Joseph	17,252	3.56
University City	2,416	2.93
Nebraska:		
Lincoln	115,125	2.10
Omaha	105,568	1.83
Nevada:		
Reno	32,030	2.11
New Hampshire:		
Dover	10,000	1.00
New Jersey:		
Camden	13,458	2.20
Collingswood	50.000	1.30
Millville	14,000	1.51
Passaic	20,000	3.50
Roselle	7,310	3.50
New York:		
Buffalo	269,205	5.99T
Ithaca	18,000	1.40Rs-3.20
Niagara Falls	2,062	4.20
Syracuse	17,155	2.60
North Carolina:		
Greensboro	93,324	1.56
Salisbury	15,000	2.42
Ohio:		
Campbell	13,000	2.52
Columbus	848	2.00
Lakewood	19,829	2.69
Ravenna	8,542	3.05
Sidney	120	3.00
Oklahoma:		
Vinita	12,000	...

	Sq. yds. laid in 1928	Cost per sq. yd. surface and base
Oregon:		
Astoria	24,850	1.02S
Oregon City	17,362	1.50
Salem	18,333	...
Pennsylvania:		
Allentown	18,000	3.00
Carbondale	1,200t	1.60
Harrisburg	2,000	2.90
Lancaster	1,500	3.55
Lansford	7,000	3.20
Munhall	1,582	1.75
Tennessee:		
Knoxville	209,000	1.65
Texas:		
Ballinger	55,000	1.40
Dallas	93,725	2.85
Denton	11,150	2.25
Fort Worth	161,319	2.25
Houston	132,662	2.24
Virginia:		
Danville	10,000	2.80
Lynchburg	48,971	0.86RS
Washington:		
Spokane	35,461	1.30
Walla Walla	25,000	1.41
Wisconsin:		
Kenosha	39,695	1.74
Wausau	10,509	1.25
Wyoming:		
Laramie	40,000	2.30
Canada:		
Regina, Sask.	45,000	4.00
New York:		
Amsterdam	.39 miles	...
Elmira	250,000Ta	...
Geneva	1,900	2.50
Kingston	6,058	1.93
Port Chester	5,800T	1.77
Rye	8,550T	2.25
Tarrytown	32,000	2.40
Watertown	10,232	1.20S
North Carolina:		
Lexington	2 milesT	.35
Ohio:		
Elyria	5,300	1.40
Fostoria	1,200	...
Oregon:		
The Dalles	8,000	1.00
Pennsylvania:		
Camp Hill	9,000	1.20
Chambersburg	9,250T	.72
Coatesville	3,000T	2.00
Elizabethtown	8,375T	.25
Freeland	60,000	.17¾
Norristown	6,000	1.43
Northampton	7,935T	...
Texas:		
Amerillo	26,354	1.50
Houston	91,033	1.60
Virginia:		
Charlottesville	8,000	.50
Harrisonburg	10,380	.85
Lynchburg	14,000	...
South Boston	4,000	...
West Virginia:		
Keyser	8,000T	2.12
Morgantown	7,475T	2.40
Wisconsin:		
Baraboo	1,000T	1.25
Marinette	1,300T	1.85
Portage	2,500	1.50
Canada:		
Fredericton, N. B.	1,966T	1.17
Warrenite-Bitulithic:		
Birmingham, Ala.	196,104	2.49
San Diego, Calif.	89,700	1.66
Boulder, Colo.	4,770	2.10
Pueblo, Colo.	15,160	2.25
Bridgeport, Conn.	44,000	2.40
Lewiston, Idaho	41,021	1.65-1.90
Jacksonville, Ill.	16,000	....
Burlington, Ia.	25,000	1.50Rs
Council Bluffs, Ia.	6,615	2.64
Keokuk, Ia.	57,332	1.67S
New Orleans, La.	....	3.15
New Bedford, Mass.	19,289	...
Taunton, Mass.	24,491	1.76
Canton, Miss.	14,000	1.95
University City, Mo.	6,140	4.60X
Bozeman, Mont.	2,000	3.40
Great Falls, Mont.	63,471	2.80
Helena, Mont.	1,053	2.05Rs
Missoula, Mont.	17,650	2.25
Harrison, N. J.	7,500	3.83
Morristown, N. J.	16,000	...
Hammonton, N. J.	25,500	....
Yonkers, N. Y.	25,826	4.54
Bismarck, N. D.	83,262	2.43
Minot, N. D.	92,000	2.45
Pendleton, Ore.	5,800	2.05
Altoona, Pa.	5,291	2.50
Grove City, Pa.	1,800	3.20
Harrisburg, Pa.	28,000	3.60
Abiline, Tex.	55,599	2.77
Dallas, Tex.	19,375	2.85
Fort Worth, Tex.	6,531	2.70
Houston, Tex.	4,454	2.24
San Antonio, Tex.	59,300	2.00
Rock Springs, Wyo.	49,000	2.78
Amasco:		
Maplewood, Minn.	7,000	.85

Notes: Rs—Resurfacing; S—Surface only; T—Includes all costs; t—Tar concrete.

Asphalt Macadam

	Sq. yds. laid in 1928	Cost per sq. yd. surface and base
California:		
Alameda	75,000	$0.22½ AB
El Sagundo	7,300	.40
Fullerton	12,505	.81
Monrovia	53,800	...
Napa	16,000	.80
Ontario	11,111	.56
Pasadena	140,305	.36-.90
Redlands	38,888B	.93
Riverside	12,535	1.53-1.62
Santa Cruz	73,276	.72
Ventura	22,222	1.08
Connecticut:		
Ansonia	10,621	1.98
Bridgeport	23,000	...
New Britain	55,000	1.75
New Haven	118,440	1.40
Florida:		
Miami	74,134B	0.50B
Orlando	64,000T	.97
West Palm Beach	50,000T	1.10
Illinois:		
Chicago Heights	100	2.95
Freeport	14,000T	1.75
Harvey	11,000T	1.10
Joliet	10,000T	...
Indiana:		
Gary	11,548	2.55
Valparaiso	7,000	1.80
Kentucky:		
Covington	7,500T	2.30
Massachusetts:		
Brockton	57,000	2.05
Easthampton	8,736T	1.91
Gardner	9,376T	2.00
Lawrence	81,638	...
Marlborough	350	...
Milton	13,000	2.20
Natick	6,000	2.50
New Bedford	129,265	...
Northampton	10,900	1.75
Peabody	13,500	2.00
Pittsfield	3,300Ta	3.25-3.65
Wakefield	5,000	1.30
Wellesley	2,500Ta	2.50
Winchester	12,560	1.57
Michigan:		
Cheboygan	2 miles	...
Escanaba	17,770T	.60
Negaunee	25,000T	1.50
Missouri:		
Jefferson City	7,800	1.85
St. Charles	100,000	.25A
Montana:		
Glendive	17,000	1.00
New Hampshire:		
Laconia	8,489	...
New Jersey:		
Belleville	4,000	1.50
Englewood	16,684	1.24
Morristown	15,000T	1.25
Nutley	22,000	1.42
Passaic	17,000	1.60
Prospect Park	10,000T	2.00
Phillipsburg	2,000	1.75
Plainfield	54,700T	1.70

Notes: A—Scarifying and resurfacing; B—Oiled; R—Repairs; Rs—Resurfacing; S—Surface only; T—Tar; Ta—Some of this is tar macadam; X—Includes all costs.

Miscellaneous Bituminous

State and City	Sq. yds. laid in 1928	Cost per sq. yd. surface and base
Amiesite:		
Wilmington, Del.	58,000	...
Hammond, Ind.	11,719	$2.45
Valparaiso, Ind.	4,000	2.15
Boone, Ia.	11,348	1.42RS
Lexington, Ky.	10,000	1.90
Moberly, Mo.	3,000	1.85S
Elmira, N. Y.	1,500	...
Glens Falls, N. Y.	8,009	2.02
Fayetteville, N. C.	30,000	2.40
East Liverpool, O.	4,346	1.80Rs
Avalon, Pa.	11,000	1.52
Mt. Carmel, Pa.	22,000	2.89
New Castle, Pa.	.011 mile	Rs
South Brownsville, Pa.	12,200	1.55-2.85
Covington, Va.	3,000	1.50
Kaukauna, Wisc.	21,309	1.69
Marinette, Wisc.	1,340	1.95
Tarmac:		
New Castle, Pa.	.011 mile	Rs
Willite:		
Stockton, Calif.	14,698	2.34
Stanolithic:		
North Tonawanda, N.Y.	3,800	2.45
Rock Asphalt:		
Sheffield, Ala.	36,000	1.61
Pine Bluff, Ark.	9,000	1.10
Miami, Fla.	5,510	1.72
Cairo, Ill.	8,000	1.35
Lebanon, Ind.	11,000	3.00
Richmond, Ind.	620	...
Washington, Ind.	7,312	2.40
Lexington, Ky.	1,200	1.10S
Lake Charles, La.	25,000	.84
New Orleans, La.	....	3.17
Bay City, Mich.	3,500	.90
St. Paul, Minn.	5,031	1.12Rs
Collingswood, N. J.	2,000	3.00R
Elmira, N. Y.	2,500	...
Tarrytown, N. Y.	350	...
Athens, O.	2,500	1.10Rs
Marietta, O.	22,518	1.10
Enid, Okla.	14,263	1.35
New Castle, Pa.	.009 mi.	Rs
Tyrone, Pa.	1,050	3.00
Cisco, Tex.	12,000	1.05
Dallas, Tex.	33,459	2.85
Ft. Worth, Tex.	135 231	2.35
Houston, Tex.	240,761	2.24
Mexia, Tex.	15,630	2.79
San Antonio, Tex.	168,300	2.00
Terrell, Tex.	11,657	2.50
Danville, Va.	200	2.80

Reinforced Concrete

State and City	Sq. yds. laid in 1928	Cost per sq. yd. surface and base
Arkansas:		
Fort Smith	7.1 mi.	...
Hot Springs	10,000	$2.15
California:		
San Mateo	1,289	2.43
Colorado:		
Fort Collins	20,258	2.00
Connecticut:		
Ansonia	5,580	3.33
Illinois:		
Alton	53,000	2.20
Belvidere	53,670	2.46
De Kalb	6,278	1.97
East St. Louis	164,559	3.17
Elgin	191,574	1.69-1.85
Evanston	38,280	3.05
Freeport	12,000	2.55
Granite City	10,000	2.90
Kankakee	20,000	2.40
Mattoon	10,000	2.50
Moline	30,000	1.60
Monticello	2,180	...
Mt. Vernon	15,000	2.30
North Chicago	28,730	2.70
Peoria	180,025	...
Tuscola	4,555	...
Indiana:		
Elwood	27,000	...
Frankfort	27,000	2.52
Gary	237,423	2.60
Hammond	91,120	2.99
Lafayette	18,978	2.08
La Porte	807	2.00
Lebanon	1,500	3.00
Peru	24,892	2.73
Richmond	9,428	2.60
Rushville	26,000	2.50
Iowa:		
Belle Plaine	6,000	2.45
Cedar Falls	12,000	2.21
Cedar Rapids	16,000	2.20
Charlton	4,268	2.29
Clinton	50,000	...
Davenport	10,415	1.97
Decorah	10,050	2.31
Iowa City	58,453	2.20
Leon	2,456	2.49
Lisbon	22,000	2.01
Mason City	52,000	1.90
Monticello	16,000	2.13
Mt. Pleasant	10,472	2.06
North English	6,000	2.15
Oskaloosa	14,000	2.10
Ossian	16,000	2.13
Salem	29,609	2.20
Stanwood	26,000	2.12
Waterloo	12,754	1.78
Wingfield	40,000	1.88½
Kansas:		
Atchison	11,000	1.72
Emporia	26,368	2.40
Independence	7,500	2.45
Salina	12,000	2.61
Wichita	36,295	1.85

State and City	Sq. yds. laid in 1928	Cost per sq. yd.
Kentucky:		
Covington	7,500	2.50
Dayton	29,981	2.50
Fort Thomas	33,866	2.72
Lexington	19,000	2.10
Maysville	18,000	3.00
Louisiana:		
Lake Charles	8 mi.	2.24
New Orleans	...	2.70
Maine:		
Augusta	19,908	3.06
Gardiner	5,125	3.48
Massachusetts:		
Brockton	10,500	3.10
Gardner	4,416	3.00
Lawrence	9,648	...
Northampton	2,912	2.35
Pittsfield	15,680	2.60-3.50
Taunton	14,087	3.82
Winchester	240	...
Michigan:		
Ann Arbor	9,600	2.00
Bay City	16,785	2.20
Flint	3,096	2.50
Halfway	40,000	2.50
Marshall	22,500	2.36
Port Huron	36,327	2.55-2.60
Royal Oak	180,000	4.00X
Minnesota:		
Crookston	39,000	2.21
Duluth	90,527	2.32
Fairmont	3,442	2.00-2.22
Hibbing	33,000	2.64
Mankato	12,668	2.24
New Ulm	4,624	...
St. Peter	5 blks.	...
South St. Paul	4,601	2.50
Winona	70,000	2.04
Missouri:		
Columbia	16,635	2.40
Maplewood	23,224	2.40
Moberley	6,400	2.65
University City	29,223	2.99
Montana:		
Great Falls	3,750	2.60
Nebraska:		
Beatrice	700	2.09
Fremont	23,208	1.82
Hastings	4,850	2.55
New Hampshire:		
Laconia	4,152	...
New Jersey:		
Bayonne	3,985	2.75
Belleville	67,351	2.49-2.68
Camden	68,353	3.26
Collingswood	100,000	2.30
Englewood	11,505	3.55
Garfield	4,500	2.85
Irvington	87,000	3.15
Millville	1,000	3.00
Nutley	22,000	2.40
Roselle	70,097	3.23
Somerville	20,500	3.48
West New York	691	4.05
New York:		
Amsterdam	2.13 mi.	3.15
Auburn	34,935	2.15
Batavia	6,028	2.90
Buffalo	26,834	7.15
Elmira	250	3.25
Glens Falls	7,146	2.49
Gloversville	3,515	2.70
Ithaca	1,500	3.00
Lackawanna	8,271	2.80
Lancaster	3,000	3.85
Niagara Falls	21,926	4.41
Port Chester	3,000	2.95
Rye	100,000	3.55
Syracuse	86,608	2.50
Tarrytown	325	5.00
Watertown	12,356	4.25
North Dakota:		
Bismarck	5,235	2.15
Fargo	34,104	2.50
Grand Forks	28,600	3.38
Jamestown	4,250	2.95
Ohio:		
Akron	42,264	2.61-3.10
Ashland	332	2.50
Bellefontaine	2,014	2.00
Bucyrus	7,134	3.13
Cambridge	23,748	4.00
Campbell	24,000	2.32
Columbus	31,925	1.95
Cuyahoga Falls	2 miles	2.40
East Liverpool	20,726	2.69
Elyria	600	2.85
Fostoria	8,000	2.18
Kent	656	2.80
Lakewood	1,425	2.60
Lorain	60,000	2.30
Mansfield	9,500	2.20
Marion	2,080	2.50
Massillon	1,500	2.40
Painesville	1,873	2.17
Salem	5,489	2.89
Sandusky	12,565	2.00
Warren	22,851	2.27
Youngstown	74,799	...
Zanesville	30,700	2.40
Oklahoma:		
Enid	111,921	2.36
Muskogee	1,771	2.47
Ponca City	4,568	2.65
Pennsylvania:		
Allentown	20,000	3.00
Altoona	89,770	2.85
Berwick	5,812	By State
Chambersburg	34,284	2.93
Charleroi	20,000	3.50
Connellsville	11,820	3.00
Donora	2,960	2.95
Easton	3,863	3.35
Clearfield	200	4.00
Johnstown	4,128	2.95-3.80
Lancaster	1,500	3.16
Lansford	23,000	3.10
Monessen	3,800	3.25
New Brighton	29,530	...
New Castle	1.88 mi.	...
Northampton	8,264	2.42
Oil City	12,583	2.86
Punxsutawney	47,000	2.49
Sunbury	90,000	3.10
Sharon	5,754	2.41
South Brownsville	3,200	3.00
Tyrone	1,000	3.00
Wilkinsburg	4,997 ft.	3.00
South Dakota:		
Aberdeen	1,880	2.60
Sioux Falls	31,500	2.00
Texas:		
Amarillo	8,907	3.00
Big Spring	70,000	2.22
Greenville	6,400	2.49
Mexia	14,680	2.35
Navasota	26,400	2.07
San Angelo	16 miles	2.27
San Benito	11,612	2.50
Waco	14,000	2.60
Wichita Falls	4,200	2.90
Virginia:		
Lynchburg	7,240	1.86
West Virginia:		
Clarksburg	33,530	3.67
Morgantown	29,435	2.15
Wheeling	32,750	2.75
Wisconsin:		
Appleton	30,000	2.25
Beloit	20,000	1.68
Green Bay	10,000	1.90
Janesville	45,414	1.67
Kaukauna	5,375	2.50
La Crosse	65,000	2.08
Racine	145,000	2.56
Rice Lake	18,364	2.39
Sheboygan	104,543	2.16X
Superior	37,885	2.50

Note: X—Includes excavation.

Concrete—Not Reinforced

State and City	Sq. yds. laid in 1928	Cost per sq. yd.
Alabama:		
Birmingham	128,826	$2.00
Gadsden	1,340	1.90
Troy	4,000	...
Arkansas:		
Hot Springs	50,000	1.95
Pine Bluff	15,000	1.90
California:		
Fullerton	4,565	1.78
Long Beach	131,665	...
Monrovia	29,336	1.80-2.25
Napa	2,000	1.80
Oxnard	6,700	...
Pasadena	38,280	1.71-1.89
Riverside	7,654	1.62
San Diego	86,233	1.61
San Mateo	39,906	2.15
San Rafael	5,000	4.20
Santa Ana	0.78 mi.	...
Santa Cruz	62,702	1.80
South Pasadena	1,666	...
Stockton	31,374	1.74
Vallejo	13,660	1.80
Venturi	333,333	2.16
Colorado:		
Boulder	13,981	1.89
Florida:		
Jacksonville	48,050	2.65
Miami	77,875	2.23
Tallahassee	20,000	1.93-2.45
Georgia:		
La Grange	16,000	1.82
Savannah	38,563	2.22
Idaho:		
Lewiston	10,000	1.94
Illinois:		
Blue Island	50,000	2.90
Evanston	94,038	2.86
Indiana:		
Avilla	0.5 mi.	2.14
Anderson	29,872	1.95
Indiana (Continued)		
Brazil	15,387	2.56
Bedford	50,000	2.00
Gary	16,987	2.25
Lafayette	3,930	1.82
La Porte	1,343	2.40
Muncie	40,912	2.48
Washington	6,812	2.50
Iowa:		
Burlington	68,000	2.05
Council Bluffs	12,226	2.20
Davenport	15,290	1.40
Le Marr	18,801	1.66
Kansas:		
Dodge City	4,500	1.98
El Dorado	4,944	2.38
Emporia	2,416	2.40
Independence	13,000	2.15
Newton	6,650	1.74
Parsons	3,350	1.98
Pittsburg	8,400	2.25
Topeka	6,000	1.60-2.20
Wichita	89,790	1.66
Kentucky:		
Georgetown	17,000	2.21
Maryland:		
Easton	1,818	2.90
Massachusetts:		
Peabody	3,000	2.00
Michigan:		
Adrian	4,735	...
Benton Harbor	10,200	2.00
Bay City	5,368	2.10
Escanaba	16,990	2.15
Hastings	3,000	1.24
Highland Park	6,649	1.89
Ironwood	6,000	3.00
Jackson	5,890	2.10
Muskegon	38,782	1.85
Niles	5,400	...
Royal Oak	3,300	...
Wyandotte	2 miles	2.05
Minnesota:		
Mankato	600	1.65
Red Wing	600	1.70
South St. Paul	14,000	2.10
Mississippi:		
Canton	1,000	1.80
Missouri:		
Cape Girardeau	22,000	1.83
Jefferson City	2,400	2.20
Joplin	75,480	1.70
St. Joseph	51,615	2.68
Montana:		
Lewistown	666	2.68
Nebraska:		
Omaha	11,162	1.46
Superior	23,000	1.95
New Mexico:		
Deming	10,860	2.50
New York:		
Niagara Falls	4,329	2.55-3.50
Seneca Falls	7,000	4.00
North Carolina:		
Fayetteville	1,200	1.90
Greensboro	11,299	1.54
Ohio:		
Newark	22,895	2.00
Sidney	4,780	2.50
Zanesville	2,150	2.35
Oklahoma:		
Ada	61,000	2.07
Chickasha	63,000	2.35
Muskogee	40,709	2.23
Ponca City	1,125	2.29
Tulsa	163,406	2.30
Oregon:		
Astoria	2,800	2.20
Oregon City	9,375	1.80
Salem	146,630	1.82
Pennsylvania:		
Clarion	1,666	...
Harrisburg	12,000	2.40
Tennessee:		
Jackson	15,000	2.00
Johnson City	50,000	1.73
Knoxville	85,374	1.40
Texas:		
Ft. Worth	2,500	...
Houston	18,801	1.30
Utah:		
Ogden	28,400	1.85
Virginia:		
Hampton	12,000	3.08
Washington:		
Chehalis	8,372	3.00
Hoquiam	25,000	2.05
Puyallup	8,000	1.75
Spokane	4,000	1.75
Yakima	46,622	2.22
Wisconsin:		
Kaukauna	4,301	2.39
Oshkosh	4,845	2.84
Sheboygan	23,494	2.11
Waukesha	54,488	1.56
Wausau	29,800	2.25
Wisconsin Rapids	3,000	2.20

Vibrolithic

City	Laid during 1928	Cost per sq. yd.
Vallejo, Calif.	5,300	$2.20½
Virginia, Minn.	19,101	...
Hastings, Nebr.	17,482	2.00
Kearney, Nebr.	9,120	2.20
Altoona, Pa.	19,800	2.90

Granite and Other Stone Block

State and City	Sq. yds. laid in 1928	Cost per sq. yd. surface and base
Delaware:		
Wilmington	125	...
Massachusetts:		
Lawrence	5,289	...
New Bedford	394	...
New Jersey:		
Bayonne	26,881	$5.40
Collingswood	1,000	3.50
Jersey City	26,850	7.31
Roselle	540	6.00
New York:		
Yonkers	11,548	7.25
North Carolina:		
Greensboro	325	4.09
Ohio:		
Kent	860	1.25
Pennsylvania:		
Scranton	2,290	6.60
Wilkesbarre	1,800	6.95

Brick or Clay Block

State and City	Sq. yds. laid in 1928	Cost per sq. yd. surface and base
Alabama:		
Birmingham	63,780	$3.75
Florida:		
Jacksonville	87,392	3.77
Orlando	650,000	2.27
Tallahassee	8,079	2.40
Illinois:		
Cairo	500	4.00
Freeport	15,000	3.75
Galesburg	85,116	3.00
Mt. Vernon	4,000	3.20
Peoria	8,986	...
Indiana:		
Brazil	14,000	1.51Rs
Hammond	207	5.50
Iowa:		
Boone	5,578	1.95Rs
Council Bluffs	2,027	3.25
Iowa City	7,430	2.89
Waterloo	4,772	2.03Rs
Kansas:		
Atchison	6,000	1.85
Dodge City	18,000	2.52
Newton	25,731	2.84
Salina	4,060	3.13
Wichita	7,150	3.00
Louisiana:		
New Orleans	....	4.05
Michigan:		
Flint	8,248	2.17
Jackson	1,131	...
Kalamazoo	1,740	3.29
Minnesota:		
Rochester	12,000	1.42S
Mississippi:		
Hattiesburg	15,000	2.05
Missouri:		
St. Charles	1,000	4.00
St. Joseph	10,645	2.60
Nebraska:		
Lincoln	7,990	2.77
Omaha	6,397	2.05
New Jersey:		
Millville	2,400	2.00S
New York:		
Endicott	23,860	4.50
Ithaca	1,500	4.50
Syracuse	14,251	4.80
North Carolina:		
Greensboro	4,553	3.73
Ohio:		
Akron	87,043	3.15-3.39
Alliance	2,000	3.16
Athens	7,000	3.27
Campbell	9,000	3.50
Columbus	53,723	3.31
East Liverpool	2,118	4.00
Lancaster	9,378	2.82
Lima	4,500	3.70
Lorain	7,500	3.80
Mansfield	19,000	3.30
Marietta	13,476	5.60
Marion	14,750	3.56
Massillon	6,000	2.81
Middletown	935	...
New Boston	12,662	3.10
Painesville	4,158	3.49
Ravenna	5,220	2.60
Sidney	133	3.30
Warren	18,500	3.06
Wooster	2,465	3.25
Youngstown	20,500	...
Zanesville	580	3.60
Oklahoma:		
Muskogee	35,803	3.22
Ponca City	12,014	3.25
Pennsylvania:		
Avalon	14,000	4.09
Butler	7,800	3.50
Connellsville	30,560	2.10
Duquesne	2,170	4.25
Easton	2,260	3.75
Ellwood City	9,000	2.50
Greenville	8,000	3.59
Hazleton	2,406	5.45
Meadville	19,935	3.73
Monessen	2,000	3.50
New Brighton	10,993	1.56
New Castle	0.3 mile	...
Oil City	787	3.82
Rankin	5,000	3.55
Sharon	442	3.68
Warren	1,500	...
Wilkesbarre	1,023	5.85
Wilkinsburg	9,746	3.50
Texas:		
Amarillo	41,442	3.10
Dallas	6,632	3.33
Eastland	4,260	2.81
Fort Worth	92,577	2.50
Houston	124,290	2.80
Lubbock	33,000	2.53
Wichita Falls	400	2.10
Wisconsin:		
Baraboo	2,000	2.00
La Crosse	2,400	3.50

Note: Rs—Resurfacing; S—Surface only.

State and City	Sq. yds. laid in 1928	Cost per sq. yd.
Royal Oak	5,200	$1.52
Three Rivers	4 blks.	...
Minnesota:		
Duluth	18,638	.48
Fairmount	2,600	.09
Red Wing	¼ mile	...
Rochester	10,000	...
Missouri:		
Columbia	6,318	...
Joplin	4,000	.50
Moberly	26,000	.60
Montana:		
Lewistown	58,203	.82
Missoula	1 mile	...
Nebraska:		
Kearney	3 miles	.11¼
New Jersey:		
Collingswood	110,000	.18
Hammonton	3 miles	...
New York:		
Elmira	10,000	...
Gloversville	1,300	.60
Ohio:		
Akron	2.1 miles	...
Ashland	10,000	...
Wilmington	6 miles	...
Oklahoma:		
Vinita	10,000	.30
Tennessee:		
Jackson	3,000	1.25
Texas:		
Amarillo	3,877	...
Cleburne	2,000	1.75
Denton	10,000	.50
Fort Worth	100,000	...
Houston	285,636	.90
Weatherford	30 miles	...
Virginia:		
Lynchburg	56,000	.40
Vermont:		
Bennington	2,000Y	1.75
Washington:		
Hoquinam	16,000	.22
Puyallup	8,000	1.50Y
Wenatchee	9,000	.45
West Virginia:		
Morgantown	26,000	.40
Williamson	3,500	...
Wisconsin:		
Berlin	2 miles	Rs
Superior	25,410	.44
Wisconsin Rapids	10,000	.09

Notes: H—Chert; Y—Cubic yards; Rs—Resurfacing.

Gravel

State and City	Sq. yds. laid in 1928	Cost per sq. yd.
Alabama:		
Florence	30,000H	$0.35
Arizona:		
Flagstaff	20 blks.	...
Colorado:		
Fort Collins	40,163	.85
Greeley	10,000	.18
Longmont	65,000	.09
Connecticut:		
Manchester	40,000	1.05
Putnam	4,000	...
Idaho:		
Burley	3,192	...
Iowa:		
Boone	1,160Y	1.24
Mason City	135,000	.12
Louisiana:		
Crowley	20,000	...
New Orleans	....	1.12
Maine:		
Gardiner	1 mile	.48
Westbrook	3,600	...
Massachusetts:		
Brockton	30,000	.65
Natick	30,000	1.50
New Bedford	8,009	...
Newburyport	3 miles	...
Peabody	4,500	.53
Wakefield	16,000	.75
Wellesley	5,000	...
Winchester	6,650	.72
Michigan:		
Flint	205,334	.81½
Hastings	6,000	.36
Ironwood	15,000	.60
Niles	10,000	...

Macadam

State and City	Sq. yds. laid in 1928	Cost per sq. yd.
Connecticut:		
Manchester	13,224	$1.45
New Britain	16,000	1.25
Florida:		
Gainesville	1,700	.76
Idaho:		
Lewiston	2.6 miles	...
Illinois:		
Cairo	5,000	...
Indiana:		
Gary	13,564	1.40
Kentucky:		
Lexington	8,000	...
Massachusetts:		
New Bedford	6,715	...
Michigan:		
Adrian	4,735	...
Missouri:		
St. Charles	25,000	.40
Montana:		
Bozeman	18,200	.50
New Jersey:		
Englewood	2,900	1.30
New York:		
Amsterdam	15 miles	...
Lancaster	7,400M	.50
Watertown	2,000	1.40
Oregon:		
Astoria	5,550	.65
The Dalles	600	.50
Pennsylvania:		
Shippensburg	250,000	1.25
Virginia:		
Lynchburg	48,100	.55

Note: M—Maintenance.

CONTROLLING CONTRACT COMPETITION

When the prospective contractor will be faced with the necessity of qualifying as to experience, capital and equipment before he can be accepted as a bidder, when his bank will have adequate information on him as a risk, when a bond house will desire more than a premium before writing business, when it will require a fair outlay of cash to buy equipment, and when standard credit terms will be enforced on all material purchases, the chances of cutthroat competition surviving will be slim. This is the objective of the A. G. C.

Recent Legal Decisions

POWER TO MAKE PUBLIC WORKS CONTRACTS MAY BE WITHIN DISCRETION OF MAYOR UNDER CITY CHARTER

The charter of the city of Lakewood, Ohio, provides that the mayor, as director of public works, shall make the terms and execute contracts for public works, which, however, are subject to the approval of the council. The duty of the council is to approve the contract, not to make it; therefore the Ohio Court of Appeals holds, State v. Wiegand, 159 N. E. 140, that one who has secured from the council a garbage contract for the construction of a crematory has no right to a writ of mandamus to compel the mayor to execute the contract. This is, under the charter, discretionary with the mayor, and mandamus will not lie to compel the exercise of a discretionary power.

RESERVATION AS DISTINGUISHED FROM DEDICATION OF PARK

The Ohio Court of Appeals holds, Gund Realty Co. v. City of Cleveland, 160 N. E. 101, that where deeds reserved land as a private park laid out for the benefit solely of those who purchased lots in the allotment of which it is a part, which will be kept up, not by the public, but by the assessments raised on these lots, this was a reservation, not a dedication of the land. The municipality could acquire it for any municipal purpose recognized by the statutes, the same as any other land, by condemnation or appropriation proceedings.

ORDINANCE REQUIRING CITY'S CONSENT TO DRIVEWAY ACROSS SIDEWALK TO OWNER'S PROPERTY VALID

The Illinois Supreme Court holds, Wilmot v. Chicago, 328 Ill. 552, 160 N. E. 206, that a city ordinance requiring owners to obtain the city council's consent to the change of grade of a sidewalk so that it can be crossed by a driveway to the owner's abutting lots is not violative of the due process of law provision of the Constitution. An ordinance permitting the city council to retain the control of the city streets and sidewalks as authorized by the Legislature is not discriminatory, oppressive, or unjust.

LIMITATION OF POWER OF MUNICIPAL CORPORATION TO ACQUIRE LAND

The powers of a municipal corporation are not enlarged by liberal construction, but are strictly construed, and any ambiguity arising out of a grant of power or a reasonable doubt concerning its existence is resolved against the municipality which claims to exercise the power. The Illinois Supreme Court holds, Washburn v. Forest Preserve Dist., 158 N. E. 801, that the power to acquire land or lands connecting forests or parts thereof, given to forest preserve districts by the Illinois Forest Preserve Act, is limited to lands actually connecting or necessary to connect existing forest preserves.

BOULEVARD NOT PUBLIC WAY UNDER MASSACHUSETTS STATUTE

The Massachusetts Supreme Court holds, Dakin v. City of Somerville, 160 N. E. 260, an action for injuries to a motorcyclist while riding on a boulevard in defendant city, that the boulevard, which was laid out and has been maintained by the city under Mass. St. 1899, c. 195, authorizing the city to take the lands comprising it, and to maintain them for the purpose of a parkway or boulevard, with the power to lay out and improve it, is not a public street or way, and that the city is not liable to travelers thereon for defects or want of repair under Mass. G. L. c. 84, section 15. Nor was the boulevard a "way opened and dedicated to public use" under G. L. c. 84, section 23. The ways referred to in that section mean ways which have been dedicated by the owner for public use with the consent of the municipality, and do not include ways within the limits of a parkway or boulevard. Judgment for defendant ordered.

MEANING OF "ALL COSTS" IN A STREET WIDENING PROPOSITION

The Louisiana Supreme Court holds, Harman v. City of Shreveport, 165 La. 412, 115 So. 638, that a proposition to issue bonds for widening streets, etc., and the incidental purchase of property, "including all costs and expenses in connection with same," authorized by the taxpayers, did not require the city to pay the entire cost of widening streets where it could require abutting owners to pay two-thirds under the statute, "all costs" being inserted to provide for incidental expenses. Under the statute the city had the right to have strips on each side of the pavement taken from the sidewalk to widen the street and assess two-thirds of the cost against the abutting owner.

LIABILITY FOR INJURY FROM OPERATION OF STREET FLUSHER

In an action for injuries caused by the negligence of a city employee who was operating a street flusher on a paved street at night, the Minnesota Supreme Court said, McLeod v. City of Duluth, 218 N. W. 892; "The authorities hold that, if the flushing of a street is authorized and done solely for the comfort and health of the general public, it is a governmental act, as distinguished from a private and corporate act, and there can be no recovery. Granting health as the primary purpose, it may nevertheless afford such special benefit to adjoining property as to make such property more valuable, and hence support a special assesment therefor. Where such street flushing is not done primarily in the interest and promotion of the public health, but in the discharge of the general duty of caring for the street—keeping it safe for use—even

though it is incidentally beneficial to the public health, recovery may be had." It was held that the purpose which prompted the city to flush its streets in the present case, primarily the cleaning of the paved streets of dirt, rubbish and obstructions, was to secure the safety and convenience of the public, and that the city acted in a corporate capacity and was liable.

RIGHT TO SELL LAND OUTSIDE CITY USED FOR GARBAGE DISPOSAL

In a suit for specific performance of a contract whereby the plaintiff purchased city land outside the limits of defendant city and used by the city in the disposal of garbage, the Michigan Supreme Court holds, Curry v. City of Highland Park, 242 Mich. 614, 219 N. W. 745, that the land was used for a governmental purpose, precluding its sale by the city council and the specific enforcement of the contract of sale. In matters relating to public health, the city acts as an arm of the state, and the property whose use is devoted to the public health is used in the discharge of a governmental function. There was no specific authority in the charter of the city or elsewhere authorizing it to sell such property at private sale.

The court cited cases holding that a city is in the discharge of a governmental function in the collecion and disposal of its garbage, and is so acting in the collection of ashes, refuse and street sweepings. In each instance the act of the municipality is in the interest of the public health and the municipality acts as the arm of the state.

RECOVERY ON PAVING ENGINEER'S CONTRACT

The Nebraska Supreme Court holds, Morearty v. City of McCook, 219 N. W. 839, that where a paving engineer has signed a contract for the construction of street paving for a city, which is delivered to the city, and is subsequently signed by the mayor by direction of the city council while the services are being performed, the execution of the contract relates back to the first signing thereof by the engineer; and if he substantially performs the service required of him by its terms, he may recover from the city the compensation therein stated, in a suit thereon, and is not required to resort to an action in quantum meruit. In such action the city may recoup damages, if any, which it has suffered because of a failure to strictly perform the contract.

PROCEEDNGS FOR PAVING OR OTHER SPECIAL IMPROVEMENTS UNDER MISSISSIPPI STATUTE

The Mississippi Supreme Court holds, McClure v. City of Natchez, 118 So. 616, that a city may make a special improvement (in this case a paving improvement) under Miss. Laws 1924, C. 194, although its initial resolution therefor does not set forth that it is to be made thereunder, the statute not requiring it. Under section 3 of the act, providing that a resolution of necessity to make special improvements shall fix a date not less than fifteen days after the date of the first publication of the resolution to hear objection to the improvement, the date of the meeting may be fixed exactly fifteen days after the first publication, though publication be necessary once a week for three weeks. The statute making the initial resolution amendable on objection, such defects are held waived in the absence of objections on account thereof. A city, though having a special charter, may have its streets and alleys paved under the statute, which expressly provides that it shall apply to all municipalities.

LIABILITY FOR DAMAGE TO LAND IN WIDENING ROAD UNDER LOUISIANA STATUTE

The Louisiana Supreme Court holds, De Moss v. Police Jury of Bossier County, 118 So. 700, that police juries, as representing and acting for the parish, are clothed with plenary and exclusive powers to regulate, by ordinance, the manner of making or repairing roads in their respective parishes. They are vested with discretion in establishing and repairing public roads. They cannot be compelled by a private citizen to make a road or repair it, but when they seek to exercise the authority vested in them they must proceed in the manner prescribed by law, and cannot appropriate, expropriate, or damage the property of a citizen for the use of the public without paying for such property or such damage under La. Rev. St., section 3360. Where a lessee's crop has been damaged by the inroad of cattle as the result of tearing down the fence by the contractor widening a road under the supervision of a police jury, it was held the lessee could recover damages therefor from the parish under the statute.

APPEAL OF SUIT TO ENJOIN PAVING CONTRACT DISMISSED AFTER COMPLETION OF WORK

Injunction was sought in the Louisiana courts to prevent the letting of a paving contract to a construction company. The suit was dismissed in the Circuit Court after hearing, and the plaintiff appealed. Soon after the suit was dismissed, however, the contract was let and the paving was done and accepted by an ordinance. The Louisiana Supreme Court, Gulf Coast Co. v. Adams, 165 La. 873, therefore dismissed the appeal, the relief sought no longer being available.

QUESTION OF LIABILITY FOR DELAY IN EXECUTION OF ROAD CONTRACT

Action was brought by a road contractor against a board of county road commissioners for negligent delay in the execution of the contract, a provision in which, headed "Liabilities of Contractors," provided for commencing work as directed by the commissioners within ten days after signing the contract. The Michigan Supreme Court held, Chase v. Clinton County, 241 Mich. 478, that if any duty or liability was imposed on the board by the provision, which was questionable, the breach could not be relied on by the contractor where the delay was caused by a court order enjoining proceeding under the contract until further order of the court, in the absence of proof that the failure to more promptly secure dismissal of the court's restraining order against the board was due to the board's negligence.

NEWS OF THE SOCIETIES

April 15-16—SOUTHERN WATER & LIGHT ASSOCIATION. Annual Convention at Birmingham, Ala.

May 13-15—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual Convention. Stevens Hotel, Chicago. Secretary, Elmer Thompson.

May 20-23—NATIONAL CONFERENCE ON CITY PLANNING. Annual Conference at Buffalo, N. Y. Flavel Shurtleff, Secretary, 130 E. 22nd St., N. Y.

June 24-28 — AMERICAN WATER WORKS ASS'N. Annual Convention at Toronto, Ont. Beekman C. Little, Sec'y, 29 W. 39th St., N. Y.

Oct. 14-16—INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Annual Convention at Jacksonville, Fla. A. M. Anderson, Secretary, 100 North LaSalle St., Chicago, Ill.

ASSOCIATION OF HIGHWAY OFFICIALS OF THE NORTH ATLANTIC STATES

The fifth annual convention of the association of Highway Officials of the North Atlantic States was held at Atlantic City, N. J., February 13-15. As usual, the meeting was well attended, there being about 1,500 present, and excellent papers were on the program. Abstracts of some of these papers appear elsewhere in this issue.

The morning session Wednesday was devoted to a continuation report by J. S. Bixby, New York State District Engineer, on specifications and conditions of concrete pavements. In the afternoon concrete control was the principal topic, with Frank G. Flood, Connecticut, W. W. Mack, Delaware; R. B. Gage, New Jersey; L. D. Brownell, New York; and W. F. Purington New Hampshire, among the speakers:

Repairs and maintenance were taken up Thursday morning, with the following speakers: C. R. Waters, New York; M. H. Ulman, Pennsylvania; Harry C. Carsten, Connecticut; W. A. Van Duzer, Pennsylvania; George E. Hamil, Connecticut; David Noonan, New York; L. D. Barrows, Maine; and A. W. Muir.

The afternoon session related to guard rails, pavements markings, traffic control, grades and curves. Friday morning, data were presented regarding culvert loading; and H. Eltinge Breed discussed joints in concrete pavements, with particular reference to "dummy joints.

Massachusetts was elected to membership in the association at an executive meeting of the board of directors, and Charles Dean, chief engineer of the Massachusetts State Highway Commission, was temporarily named to a place on the board.

AMERICAN WATER WORKS ASSOCIATION

Florida Section

The Nominating Committee of the American Water Works Association has selected the following nominees for the various offices to be filled at the Toronto Convention for 1929-30. In case no other independent nominations are filed, as provided for in the Constitution, the report of the Nominating Committee will be considered as an election.

For president, Jack J. Hinman, Jr., Associate Professor of Sanitation, University of Iowa, Icwa City, Iowa; for vice-president, George H. Fenkell, Superintendent and General Manager, Board of Water Commissioners, Detroit, Mich.; for treasurer, George C. Gensheimer, Secretary, Commissioners of Water Works, Erie, Pa.; for trustee, District No. 3, J Walter Ackerman, City Manager, Watertown, N. Y.; for trustee, District No. 5, A. F. Porzelius, Superintendent, City Water Co., Chattanooga, Tenn.; for trustee, District No. 7, W. T. Mayo, Commissioner of Public Utilities, Shreveport, La.

The next annual convention of the Association will be held at Toronto, Ont., during the week of June 24th, 1929, at the Royal York Hotel. At this meeting a matter of great importance to the Association will be brought up, namely, the presentation of a proposed new constitution. A committee has prepared a draft of this constitution which will be submitted to the members at the convention for their consideration.

At a meeting of the executive committee held recently in New York City, the publication committee's report showed that a very complete and diversified program of papers had been obtained, and this program will be mailed well in advance of the convention dates.

It is urged that those desiring accommodations at the convention headquarters advise the Royal York Hotel as early as possible. A letter of inquiry to the hotel management will enable you to obtain the rates for such accommodations as are desired.

KENTUCKY ASSOCIATION OF HIGHWAY CONTRACTORS

The Kentucky Association of Highway Contractors elected Ashby Corum, of Madisonville, as president, at the eighth annual meeting at the Seelbach Hotel, Louisville. The association's annual banquet was hel dat the Seelbach with Mayor William B. Harrison as guest of honor.

J. M. Perkins, of Frankfort, was elected first vice president; Drury Smeathers, Owensboro, second vice president, and D. R. Lyman, Louisville, secretary. Directors are E. R. Ackerman, Lexington; George B. Carey, Lexington; W. W. Carter, Cunningham; George M. Eady, Louisville; J. C. Codell, Winchester; J. B. McClellan, Bowling Green, and F. W. Graham, Pineville, the retiring president.

NEW JERSEY SEWAGE WORKS ASSOCIATION

The New Jersey Sewage Works Association, the Engineering Bureau of the State Department of Health of New Jersey cooperating, will hold its fourteenth annual meeting on March 22nd and 23rd, 1929, at the Stacy-Trent Hotel, Trenton, New Jersey.

The meeting is planned for municipal officials, particularly those connected directly or indirectly with sewers, sewage disposal and allied activities and provides an opportunity for the exchange of in-

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Pavement Repairs increase in cost every year. The Adjustable Manhole Top cuts down this expense 90% in cost of replacements.
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No caulking is necessary with JOINTITE. Alternate joints may be poured on the bank. No skilled help required. Excludes ground water, thus paying for itself.

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Catalog No. 29—Sewage Pipe Joint Compound.
Catalog Nos. 30 and 24—Automatic Siphons for Large Municipal Disposal Plants, etc.
Catalog No. 31—Imhoff Tanks.

Catalogs mailed on request.

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formation and ideas through the medium of round table discussions. Authorities will present papers on various phases of sanitation, which with the discussions will be of practical value to those attending the meeting.

NEW YORK STATE CHAPTER ASSOCIATED GENERAL CONTRACTORS

The third annual convention of the New York Chapter of the Associated General Contractors will be held at the Hotel Syracuse, N. Y., March 13 and 14. Meetings will be held on the afternoon and evening of the 13th, and morning and afternoon of the 14th. The banquet will be held Thursday evening.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION

The twenty-third annual meeting of this association was held in Washington, D. C. February 13-15. There was a good attendance at the meeting. Two sessions were devoted to discussions of the latest practicis in design and construction of streets and highways. Other sessions were devoted to industrial and manufacturing problems of the industry.

NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION

The 16th annual meeting of this assocsociation was held at the Hotel Traymore, Atlantic City, N. J., February 13-15. Among the speakers at the opening session was Dr. L. O. Howard, principal entomologist of the U. S. Bureau of entomology, who reviewed mosquito control activities throughout the world. Frank W. Miller, associate entomolgist of the New Jersey Agricultural Experiment Station reviewed the accomplishments in New Jersey during 1928. The common "house mosquito" was the predominating species found in New Jersey during the past year. Mr. Miller said. "This species breeds for the most part in water contained in receptacles often maintained in and about the house," he stated. "These include rain barrels, tubs, cisterns, cesspools, clogged roof gutters, sink drains and even tin cans. "Mosquito breeding from these sources is difficult to control with the result that enormous increases in our mosquito population follows. County mosquito fighting organizations cannot attempt to inspect for and eliminate mosquito breeding areas, in every back yard of the country. Such a program is impractical both from a physical and financial point of view.

"Such being the case, it is vital that the householder co-operate in the elimination or control of breeding places, and clean up his own back yard, especially in seasons of wet weather."

Referring to the work of county mosquito commissions. Mr Miller stated that "due to their efforts, the mosquito annoyance in 1928 was immeasurably reduced." He mentioned specifically the mosquito-fighting organizations in the counties of Bergen, Passaic, Essex, Hudson, Union, Morris, Middlesex, Monmouth, Ocean, Atlantic and Cape May.

James E. Brooks of the Essex county Commission discussed recent developments of mechanical appliances used in control and Dr. J. M. Ginsberg of the N. J. Agricultural Experiment Station, spoke on the Toxicity of Oil, and also, with John P. Peterson of Bergan County on the use of waste motor oil.

AMERICAN ENGINEERING COUNCIL

The American Engineering Council at its recent annual meeting in Washington voted to appoint a committee "to study and report to the Council on the activities and performances of the Corps of Engineers."

This action was precipitated by the opposition of the Corps to the bill providing for the establishment of a National Hydraulic Laboratory in the Bureau of Standards. The bill has passed the Senate, and is now before the Rivers and Harbors Committee of the House.

The President of the Council, Arthur W. Berresford of New York, explained that the study would be in thorough accord with engineering methods, and that the Corps of Engineers would be invited to name a representative on the committee.

The report of the Council's committee on Street Traffic Signs, Signals and Markings received final approval. The report will be published in the near future. It represents the findings in surveys made in thirty-five states. All conditions and methods of traffic control are believed to be covered.

The American Institute of Consulting Engineers was elected to membership in the Council. O. D. Koch, representing the Technical Club of Dallas, and L. P. Alford of New York, representing the American Society of Mechanical Engineers, were named Vice Presidents of the Council. Dr. Harrison E. Howe of Washington, representative of the American Institute of Chemical Engineers, was re-elected Treasurer. Lawrence W. Wallace of Washington was re-elected Executive Secretary, a post he has held since 1920, when the Council was organized under the presidency of Herbert Hoover.

CHICAGO ASSOCIATION OF CONSULTING ENGINEERS

The Chicago Association of Consulting Engineers at their Ninth Annual Meeting, held at the City Club, Chicago, elected officers for the ensuing years as follows: Ernest V. Lippe, president; Rollo E. Gilmore, vice-president; H. L. Clute, secretary-treas.

AMERICAN WATER WORKS ASS'N

Florida Section

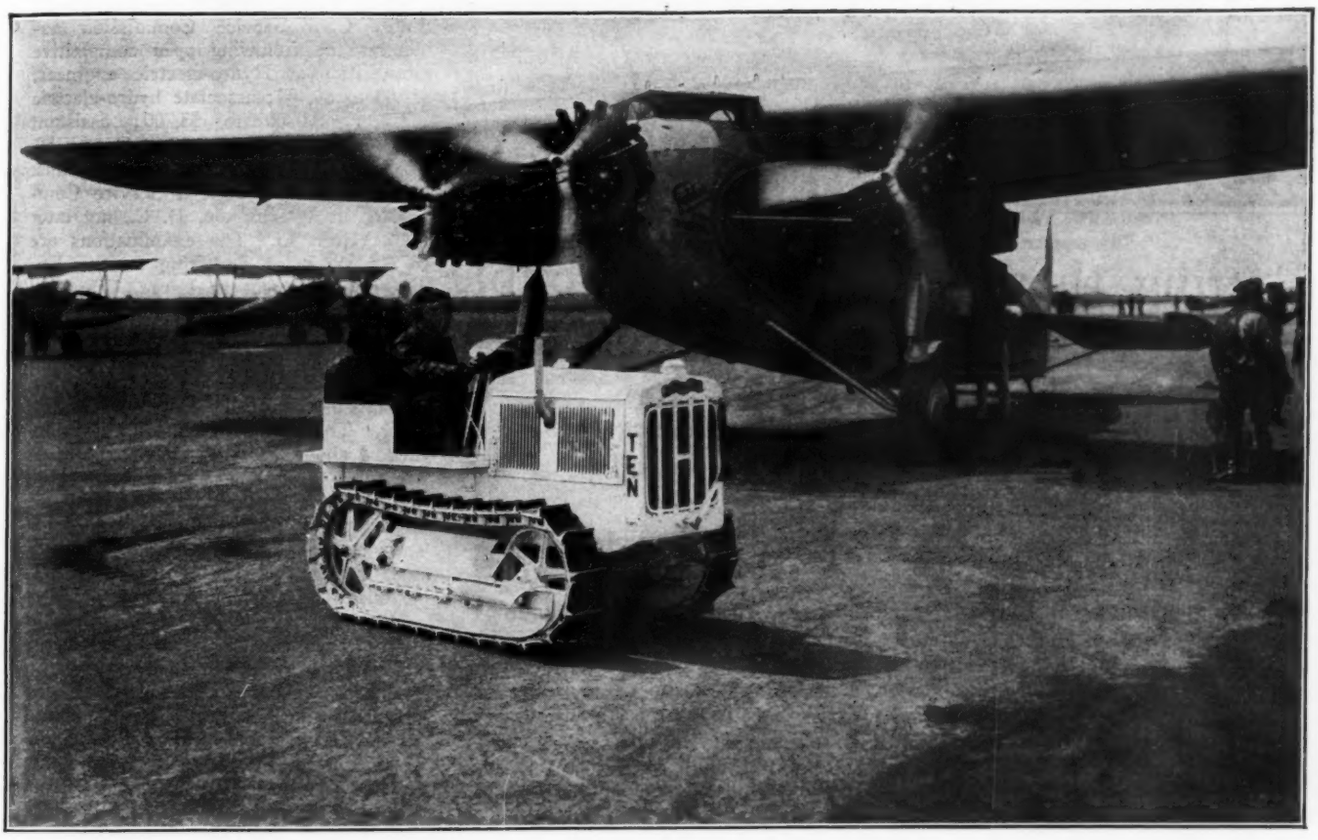
The next meeting of this section will be held April 10th and 11th, 1929, at Jacksonville, Florida. E. L. Filby, chief sanitary engineer, State Board of Health, Jacksonville, Florida, is secretary.

CIVIL SERVICE

Materials Testing Engineer.—Application for Materials Testing Engineer, $3,-800 a year, Associate Materials Testing Engineer, $3,200 a year and Assistant Materials Testing Engineer, $2,600 a year must be on file with the Civil Service Commission at Washington, D. C., not later than March 27. The examinations are to fill vacancies in the Bureau of Standards, Department of Commerce, Washington, D. C., and in positions requiring similar qualifications. Entrance salaries for these positions are as specified above. Higher-salaried positions are filled through promotion. Competitors will not be required to report for examination at any places, but will be rated on their education, experience, and fitness, and reports on these to be filed by the applicant.

Topographic Draftsman.—Applications for senior topographic draftsman, $2,000 a year; topographic draftsman, $1,800 a year; assistant topographic draftsman, $1,620 a year; junior topographic draftsman, $1,440 a year; must be on file with

The Airminded "Caterpillar" Tractor



Landing fields to be kept smooth, planes to be pulled from hangars, snow to be pushed aside, . . . all sorts of jobs to be done from heaving a big tri-motor out of the mud to doubling for a disabled stationary engine.

The "Caterpillar" track-type tractor is airminded. Agile, sure-footed, powerful ground-gripper that it is, the "Caterpillar" has become an indispensable friend to the flyer at a score of airports. Here is the new Model Ten helping a tri-motored Fokker out into the open.

There is a "Caterpillar" dealer within reach of your phone. Ask him how "Caterpillars" help to keep the upkeep of airports down.

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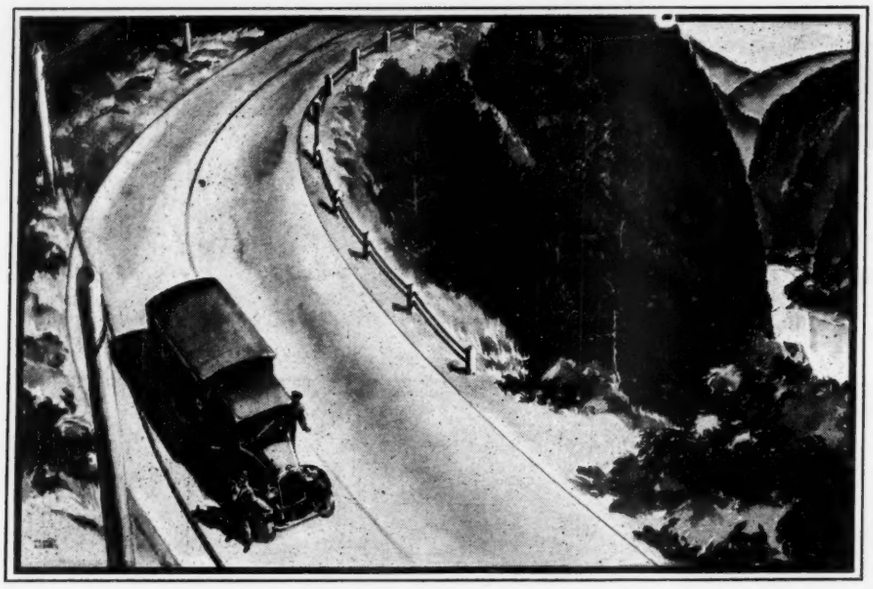


Getting there ahead of the trouble

An Advertisement
of the
American Telephone and Telegraph Company

During the afternoon of March 17, 1928, an alarm bell rang in a telephone test station in the heart of the Alleghany mountains. This meant that a puncture had been made in the air-tight sheath of a busy inter-city cable. The men on duty knew that the injury was somewhere within 50 miles.

Highly developed locating devices were instantly applied and in sixty-five minutes the trouble spot was located. By 7.15 in the evening, before the break in the sheath had affected service on any of the 248 pairs of wires in the cable, the repairs had been made. Because of the preliminary warning on the indicator wire and the locating devices that enabled the test station to tell the repair crew just where it would find the trouble, not one conversation was interrupted. This special alarm system is one of the many mechanical and electrical wonders developed by Bell System engineers to guard telephone conversations. The apparatus is placed along the cable routes at intervals of 100 miles. It gives instant warning day or night of any disturbance to the cable within 50 miles in either direction. Automatic warning signals, electrical locating devices, constant testing of all switchboard apparatus and circuits—these are some of the ceaseless efforts that so effectively reduced interruptions to service on Bell lines in 1928.

There is no standing still in the Bell System. Constant progress in accuracy and better service at the lowest cost is its goal.

"The Telephone Books are the Directory of the Nation"

the Civil Service Commission at Washington, D. C., not later than March 20.

The examinations are to fill vacancies in the Departmental Service, Washington, D. C., and in positions requiring similar qualification throughout the United States. The entrance salaries of these positions in the Departmental Service, Washington, D. C., are as indicated above. For appointment outside of Washington, D. C., the salaries will be approximately the same. Competitors will not be required to report for examination at any place, but will be rated on their education, experience, and fitness, and topographic drawing and lettering.

Junior Cartographic Engineer. Applications for junior cartographic engineer must be on file with the Civil Service Commission at Washington, D. C., not later than March 20. The examination is to fill vacancies in the Coast and Geodetic Survey, Department of Commerce, for duty in Washington, D. C., or in the field. The entrance salary is $2,000 a year. Higher-salaried positions are filled through promotion. The duties are technical in character, and consist in the utilization of the data resulting from the field surveys of the Bureau, or obtained from a wide variety of miscellaneous sources, in the compilation and correction of nautical charts which guide all vessels traversing the navigable tidal waters of the United States and its possessions, and of other professional work in related physiographic problems.

Competitors will not be required to report for examination at any place, but will be rated on the drawing and lettering test, material for which will be furnished by the Commission to applicants after their applications are filed.

Hydro-Electric Engineer.—The United States Civil Service Commission announces the following open competitive examinations: Hydro-electric engineer, $3,800 to $4,400; associate hydro-electric engineer, $3,200 to $3,700; assistant hydro-electric engineer, $2,600 to $3,100.

Applications for these positions must be on file with the Civil Service Commission at Washington, D. C., not later than March 13. The examinations are to fill vacancies occurring in the Engineer Department at Large, War Department, throughout the United States, and in positions requiring similar qualifications. At present there is a vacancy in the associate grade in the Chattanooga, Tenn., District of the Engineer Department. The entrance salaries are as indicated above. Higher-salaried positions are filled through promotion.

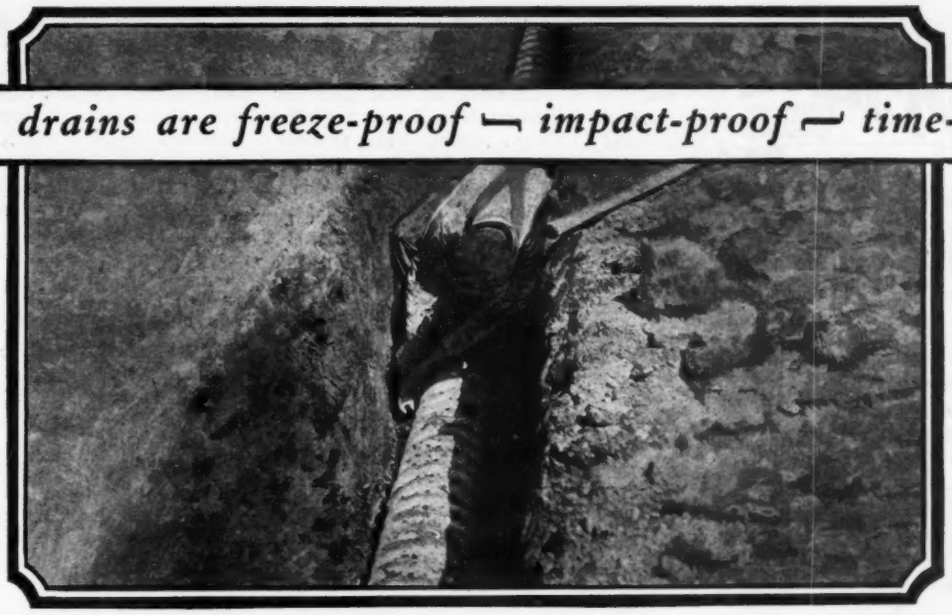
The duties are in connection with the investigation and complete study of streams to determine power, navigation, and flood-control possibilities. This will include a study of potential power sites and regulating reservoirs of a particular district, available for hydro-electric development to determine their value as individual developments and as parts of a comprehensive scheme of combined stream and hydro-electric superpower development for the entire territory within economical transmission radius. Embraced in the work will be the following: Selection of sites, tentative designs and estimates of cost, field reconnaissance, a study of transmission and marketing of power, final study, design, preparation of plans, and estimate of cost. Competitors will not be required to report for examination at any place, but will be rated on their education, training, experience, and fitness, and writings to be filed by the applicant.

Information.—Full information may be obtained from the United States Civil Service Commission, Washington, D. C., or from the secretary of the United States Civil Service Board of Examiners at the post office or custom house in any city.

PERSONALS

Frank T. Sheets has been re-appointed chief highway engineer of Illinois by Governor Louis L. Emmerson, who recently took office. Mr. Sheets has been associated with the Illinois Division of Highways for the past 22 years, and for the last eight years has been the

These drains are freeze-proof — impact-proof — time-proof



"We installed our drains— Once and for all"

"WE wanted protection against wet and soggy grounds for more than just today—for years and years to come.

"We had experience with rigid types of drains and realized their shortcomings. For one thing, trucks, tractors and rollers were frequently run over the grounds so our drains must be resistant to impact to give continued service.

"An investigation convinced us that Armco perforated pipe would give us years of service. We saw Armco corrugated iron installations that had been in use more than 20 years. Another thing, with this flexible pipe we did not need to pay any attention to the frost line, which meant less excavation and lower costs. Armco perforated pipe, because it is flexible, absorbs the pressures of freezing water and soil without damage. Swelling, shifting and heaving soils cannot crack or disconnect it."

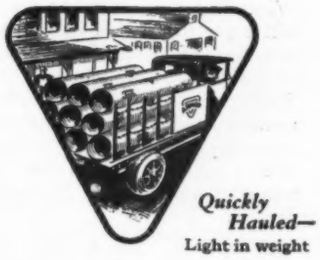
Complete information on this better, safer subdrain pipe will be sent on request. Write today.

Armco culverts and drains are manufactured from the Armco Ingot Iron of The American Rolling Mill Company and always bear its brand

ARMCO CULVERT MANUFACTURERS ASSOCIATION

Middletown, Ohio

Quickly Obtained—
Long sections—immediate delivery



Quickly Hauled—
Light in weight

Quickly Installed—
Flexible, it cannot break

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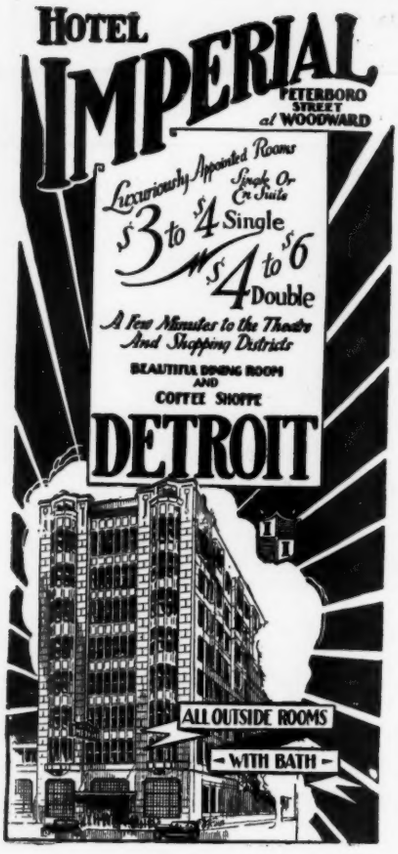
ARMCO *perforated* PIPE



chief engineering and administrative officer of the Division. He is past president of the Mississippi Valley Conference of State Highway Officials and the American Association of State Highway Officials, and a member of the American Society of Civil Engineers.

G. Morton Wolfe, architect and engineer, Buffalo, N. Y., is preparing plans and specifications for a ten million dollar project for the Universal Wireless Communciation Company and will have under his direction the construction of about 350 buildings scattered throughout the whole United States. These buildings will be used for transmitting and receiving of short wave commercial messages. The transmitting station of the New York unit is now being completed at Scobeyville, New Jersey.

Michael L. Quinn, one of the best known tunnel builders of the country, died in New York recently. In 1911, Mr. Quinn was General Superintendent for the Pittsburgh Contracting Company, on Board of Water Supply Contract No. 65, covering seven deep shafts and about five miles of tunnel in upper Manhattan; in 1914, with Flinn-O'Rourke Company, on the William St. river tunnels and the Battery tunnels to Montague street, Brooklyn, General Superintendent on Route 33, Section 3, from Flatbush Ave. and Willoughby St. to Borough Hall, Brooklyn; in 1917, General Superintendent for Both & Flinn, Ltd., on the 14th St. river tunnels and open-cut section from Irving place to Sixth avenue; in 1920, General Superintendent on the Liberty tunnels, Pittsburgh, Pa.; in 1922, General Superintendent on Contract No. 3, being the Manhattan side of the Holland vehicular tunnel. Later, upon the death of L. Tallman, he took over the work on Contracts Nos. 4 and 6 of the Holland Vehicular tunnel. Prior to coming with the Pittsburgh Contracting Company, he had been with the Cleveland Tunnel Construction Company, near Peekskill, N. Y., and with T. A. Gillespie Company, at High Falls, N. Y. He also worked with the United Engineering Company, on the 34th Street section of the Pennsylvania tubes. In the past year he completed a tunnel in New Brunswick, Canada.

BOOK REVIEWS

Sewerage.—By A. Prescott Folwell. Tenth Edition, rewritten and reset. 399 pages, 121 illustrations. $4.50. John Wiley & Sons, Inc.

The tenth edition of this famous book possesses all the characteristics that have made it one of the most popular and valuable technical books ever published. This edition has been entirely rewritten, and advantage has been taken of this to change the paragraphing and arrangement to facilitate reference, and to employ recent data and illustrations.

In recent years the subject of sewage treatment has received increasing attention and has been of growing importance. This problem is treated thoroughly and adequately in the present edition, especial attention being paid to most recent developments in methods of, and equipment for, treatment. Chapters on treatment include: Disposal by dilution; removal of suspended matter; oxidizing methods; sludge digestion and gas utilization; final disposal of sewage solids; and, other treatment methods. The trend toward mechanization of treatment is considered. That part of the book relating to sewerage systems also has been revised and brought up to date. Some matter has been extended, especially that relating to storm-water run-off, which is fully and clearly treated.

In appearance, the tenth edition surpasses its predecessors. The type and make-up are good; the illustrations are exceptional in clearness and in their ability to bring out exactly the points that should be emphasized.

Vom Wasser. Yearbook for sanitary chemists and engineers. Verlag Chemie, G. m.d.H. Berlin, W 10, 280 pages, price paper 14 marks; bound 16 marks.

(*Reviewed by Prof. Willem Rudolfs*)

Twenty six papers delivered before the 1928 Convention of German Sanitary Chemists held at Dresden in 1928, together with brief discussions compose the book. A paper by Professor Haupt describes the progress made in surface water treatment. Olszewski gives the newest results on disinfection of swimming pools. Merkel has a contribution on our knowledge of sewage chlorination, dealing with B.O.D. reduction; Egger describes methods of determining oxygen, chlorine and chloramin consumption and attempts to correlate the results. Beseman presents results on the chlorine consumption of distilled water to which different organic ingredients have been added, while finally Ornstein gives a review of American practice in chlorination of water and sewage. Rapid sand filters of the Bollman type, which are considered to be nearest the ideal, are discussed by the originator. Smit discusses the results of B. coli determinations in connection with the question of so-called pollution caused by cold blooded animals (frogs, etc.) A long and extremely interesting resume is given by Splittenger on the question of condenser water and its effects. Stephan presents analytic results on the behavior of silicic acid in solution on boilers and the treatment of the water. The use of colloids to prevent scale formation is described at length, while the treatment of water for industrial washing purposes is included.

An interesting paper on the composition and disposal of the Berlin sewage gives data dealing with the solids content of the sewage, the temperature, pH values and gas produced. The amount of gas is 8.4 cu. ft. per mil. gal. sewage. The sewage disposal system of Dresden is described and also two interesting papers on the biological disposal of sewage in fish-ponds. Gas production from sewage sludge in Halle shows an average of 73.5% methane, 14% CO_2, 4.8% hydrogen and 4.7 nitrogen. Laboratory experiments on the effect of lime on sludge digestion conducted by Bach of the Emschergenossenschaft, substantiates the findings in this country. Two papers dealing with water consumption and waste disposal of the sugar-beet industry completes the volume. The book brings much of interest which is augmented by the addition of the brief discussions. A number of the papers have permanent valvue. The print is clear and in roman characters. The paper cover makes the book flimsy.

TRADE PUBLICATIONS

Road Machinery.—The "Autograder," the "Motograder," and the "Chip Spreader" are recent pamphlets put out by the Good Roads Machinery Co., Inc., Kennett Square, Pa.

The Trackson Crane.—The Trackson Co., Milwaukee, Wisc. A 4-page illustrated bulletin describing the new Trackson McCormick-Deering industrial crane.

Curing Concrete Highways.—The Grasselli Chemical Co., Cleveland, O. A 26-page illustrated booklet describing the use of Grasselli R-B silicate of soda in curing concrete pavements.

Rotator Rock Drills.—Sullivan Machinery Co., Chicago, Ill., has just published a 32-page illustrated booklet describing rotators for all kinds of rock drilling.

By Cleanliness the Race has Grown

The regal magnificence of the court of Louis XIV overshadowed in splendor's display even the pomp of imperial Rome . . . But it shone as a jewel in a barnyard's muck! For radiating from it were the streets of the poor—abominations in slop and dirt—incubators of epidemic disease.

Step by step cities have advanced since then. Phase by phase the public health has been improved. In the van of the march have been the great crusaders for hygiene and sanitation.

And to 20th century sanitation Bartlett-Snow contribute the Sterling Destructor for waste disposal. A Sterling Destructor consumes garbage and refuse by fire. The products of its furnaces are sterile, odorless gases and a little ash. It cannot give offense.

Read about it in our interesting Sterling Destructor booklet.

THE C. O. BARTLETT & SNOW CO.
6221 Harvard Ave. Cleveland, Ohio

Bartlett - Snow

Refuse Disposal Plants

New Appliances and Equipment

Describing New Machinery, Apparatus, Materialsand Methods and Recent Interesting Installations

The New 1-Yard Lorain-55

Thew Shovel Company, Lorain, Ohio, has brought out the Lorain-55, a new 1-yard center drive crane, clamshell, dragline and shovel. This machine is closely patterned after the 1¼-yard Lorain-75. It has been developed, designed and built on an entirely new superstructure of a size, weight and strength throughout to handle a 1-yard struck measure dipper.

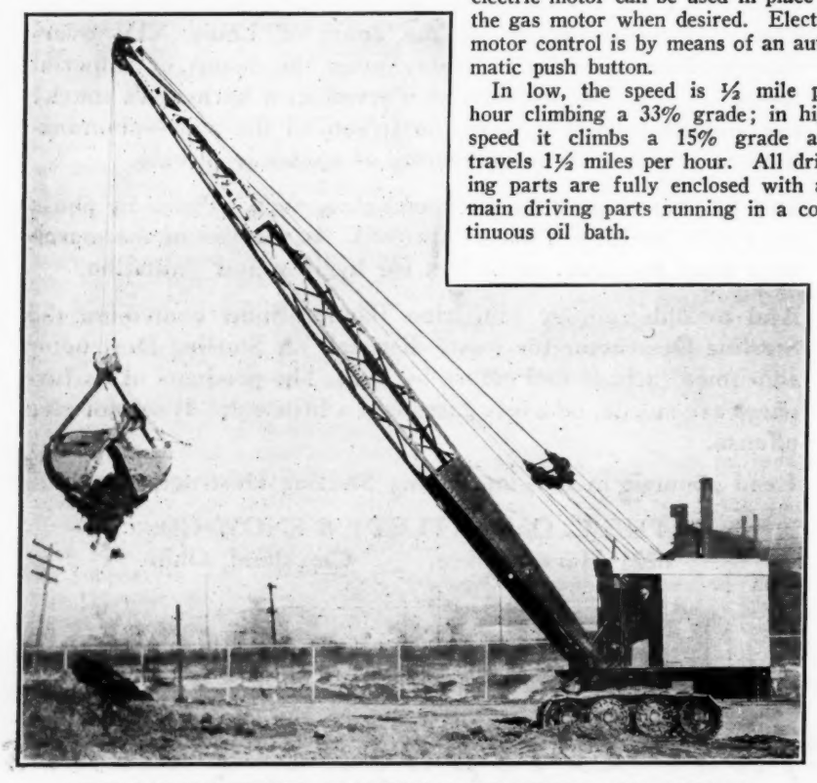
In its applications the new Lorain-55 has been developed as a 1-yard crane, dragline and shovel and particular attention has been paid to incorporating in it features that will improve its operation as any of these units. For the crane, clamshell and dragline units new style booms have been developed on the basis of greatest strength with the minimum weight to insure the greatest possible stability to the unit. Booms are furnished in 35, 40 and 45-foot lengths, or longer if desired.

The 35-foot boom is a steel single piece, straight channel type, strongly tied together by ample cross-bracing. The 40 and 45-foot booms are box section, latticed steel, in two sections, with interchangeable heads. For longer booms suitable center sections can be furnished. The cross-bracing on the 40 and 45-foot booms is tubular, giving strength at minimum weight; the bases are reinforced with heavy steel side plates. The 40 and 45-foot booms are parobolic, or cigar shaped, making a very neat appearance. The boom hoist on the Lorain-55 is by means of a power driven self-locking worm drive, with a secondary boom hoist brake.

The new machine has a tail swing of only 9 feet, a valuable asset for work in small excavations or cramped quarters. This reduced tail swing is largely due to the use of the Thew center drive on the turntable. The Lorain-55 can hoist, swing and travel, or derrick the boom, all at the same time.

The power plant is a Waukesha "JL" gasoline motor, 6 x 7, with Ricardo Head. Automatic governor, air cleaner, and a 50 gallon fuel tank are standard equipment. A 40 h.p. electric motor can be used in place of the gas motor when desired. Electric motor control is by means of an automatic push button.

In low, the speed is ½ mile per hour climbing a 33% grade; in high speed it climbs a 15% grade and travels 1½ miles per hour. All driving parts are fully enclosed with all main driving parts running in a continuous oil bath.



NEW LORAIN CRANE, CLAMSHELL, DRAGLINE AND SHOVEL

The Hi-Way Shoulder Finishing Machine

The Highway Shoulder Machine Co., Effingham, Ill., has brought out a machine especially designed for shoulder construction and maintenance. The machine was designed by an experienced highway contractor to meet a practical requirement to overcome high costs and slow production. It has been used in Michigan, Indiana, Wisconsin, Iowa and Illinois, and is employed by the Illinois State Highway Department both for maintenance and on new construction.

HIGHWAY SHOULDER MACHINE

It is claimed that this machine can be used when hand methods and other equipment would be greatly hampered on account of weather or soil conditions.

Shoulder finishing crew consisting of foreman, tractor operator, shoulder finishing machine operator, and helper will finish from one to three miles of shoulders per day, it is claimed, the saving in labor on two to four miles of shoulders will pay for the machine.

The draw bar pull is directly in line with the load, and all four wheels ride on pavement. The strain of normal operation is on the blade and draw bar, thus eliminating bending and twisting strains on the carriage.

The blade cuts off excess dirt and carries and deposits the excess in low places, thus building the shoulder to correct grade and line.

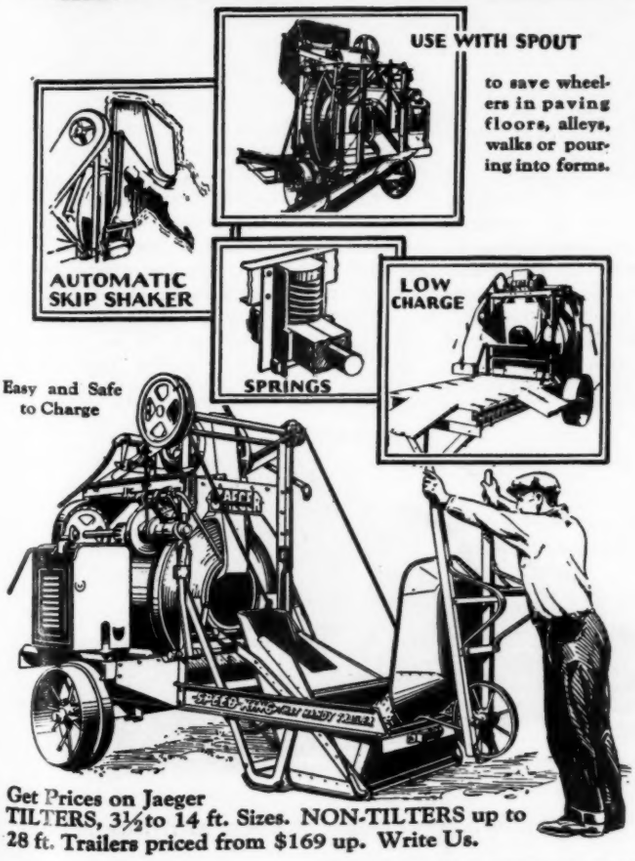
The carriage is 14 feet long and 8 feet wide; the auxiliary slope blade is 2½ feet long; the total weight of machine 4,000 pounds.

The machine is easily dismantled for shipment by rail; or it can be hauled on a two ton truck. A Fordson will pull it but 5-ton tractor is recommended for smooth operation, a cable hitch being required between machine and tractor. The essential adjustments provided are: Horizontal swing of main blade 90 degrees; vertical range of blade 8 to 12 inches; maximum slope of main blade 4 inches in 6 feet; maximum slope auxiliary blade 1 to 1. Standard blade widths are 6, 7½ and 9 feet, but wider blades can be furnished.

This All-Purpose Mixer has earned its name — SPEED-KING

One Man End Control!

Famous Jaeger One-Bag Mixer with End Discharge ∽ Built of Steel ∽ Fast ∽ Portable ∽ Easy to Handle


USE WITH SPOUT
to save wheelers in paving floors, alleys, walks or pouring into forms.
AUTOMATIC SKIP SHAKER
SPRINGS
LOW CHARGE
Easy and Safe to Charge

Get Prices on Jaeger TILTERS, 3½ to 14 ft. Sizes. NON-TILTERS up to 28 ft. Trailers priced from $169 up. Write Us.

IT takes only 5 seconds to charge, and 7 to 10 seconds to discharge this mixer. It needs only about 6 feet of street room. It's *spring mounted* on two roller bearing wheels with dual tires (for soft ground and pavements); it's 50% stronger and ½ ton lighter because it's built of steel.

In other words, here's a *fast, compact, portable, sturdy* one-bag trailer with all the special Jaeger features that make Jaeger the world's leader in mixer sales. Check the points here illustrated on this machine. They tell the story.

You can buy this mixer at a price under the market. And back of it is the quick, reliable service of over 100 Jaeger stations in principal cities and towns.

Ask us also about Handy 3½ S Trailer for $169 up.

— Mail this slip for Catalog and New Prices —

THE JAEGER MACHINE COMPANY.
400 Dublin Ave., Columbus, Ohio

Please send catalog, prices and terms on
NON-TILTS TILTING MIXERS
PLASTER MIXERS

Name _____

Address _____

_____

Link-Belt Line of Gasoline Locomotive Cranes

Link-Belt Company, Chicago, Ill., has announced a complete line of locomotive cranes designed especially for gasoline engine, diesel engine or electric motor drive, to be known as the "L" type cranes. These are not merely modified steam cranes, but are designed throughout for the entirely different and much more severe conditions imposed by a power unit running continuously at its full operating speed, it is stated.

LINK BELT "L-75" GASOLINE CRANE

The machinery and its arrangement are adapted to direct engine or motor drive, and all clutches, brakes, shafts, bearings, gears, etc., are oversize in order to give the best operating results and the lowest possible maintenance expense, under these conditions.

The drive from engine or motor is a totally-enclosed silent chain drive, and all upper frame gears have machine cut teeth, cut from solid blanks. This makes a quiet, smooth operating machine of the very highest efficiency.

These cranes are furnished with two-speed travel gear to give a high travel speed for traveling light, and a slower travel speed for pulling heavy loads or ascending comparatively steep grades. The two-speed travel gear in no wise affects the other speeds of the machine (hoisting, boom hoisting and rotating), which remain unchanged in order not to affect the operating speed and handling capacity of the machine.

The addition of the "L" type crane in five sizes gives Link-Belt Company a complete line of gasoline, diesel, electric and steam locomotive cranes, and a line of heavy duty gasoline, diesel, or electric crawler shovels-cranes-draglines ranging from ¾-cu. yd. to 2-cu. yd. capacity.

New Buhl Portable Air Compressors

The Buhl Co., Chicago, Ill., has brought out a new line of portable air compressors which, it is claimed, offer a wide choice of size and style, while incorporating many advanced features of efficiency and economy. They can be supplied in sizes from 30 to 330-cubic foot size, and in any style mounting. All parts, with the exception of the crank shaft unit, are interchangeable on all sizes and types.

The DB-30 is a water cooled, 2-cylinder compressor, which has a displacement of 36 feet at 1200 rpm. It is powered with a Continental P-10, 2-cylinder engine, which can be completely enclosed. A canopy covers both engine and compressor, and the unit can be supplied in any mounting.

Vitrified Cradle Base Drain

The Ric-Wil Co., Cleveland, O., manufactures a vitrified cradle and drain for sewers. The Ric-Wil cradle base is a vitrified tile support and subdrain for sewer pipe. It gives the sewage system a solid foundation, with drainage, and is claimed to be economical in wet ground.

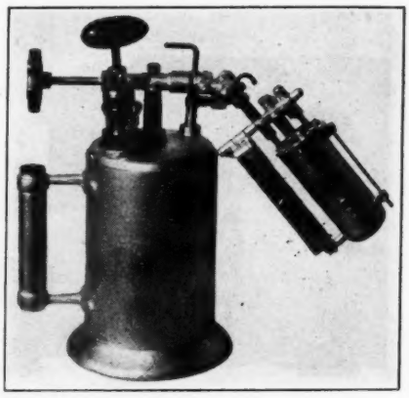
It grades, aligns and centers the sewer pipe automatically. It eliminates all digging of bell holes and bedding of sewer pipe, and also the laying of a crushed stone base. It eliminates the delay and labor of making concrete base. It can be laid in muddy trench, and its use eliminates pumping except in extreme cases.

Staggered interlocking construction spreads the load, gives continuous support and increases the strength of the sewer pipe. It is claimed that it produces the tightest, strongest, most permanent and satisfactory sewer it is possible to obtain.

The Ric-Wil Company also manufactures the Ric-Wil sewer pipe joint compound, which is claimed to have many advantages in making permanent, waterproof and root-tight joints, and Ric-Wil impregnated tape. This is a coarse, porous adhesive tape, impregnated with bituminous asphalt, for use in wrapping farm drain tile and sewer joints to prevent seepage of sand and dirt into drain. It sticks to the tile, requiring no tying or wiring. It is waterproof and durable, and as economical to use as tar paper or burlap.

Williams "Universal" Heating Torch

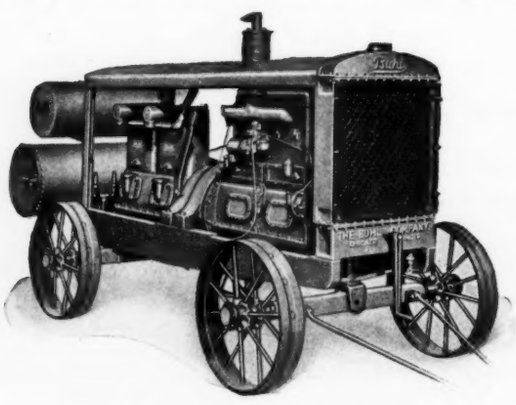
The G. H. Williams Co., Erie, Pa., manufactures an unusual torch that is claimed to heat in one-third to one-half less time than the usual torch.



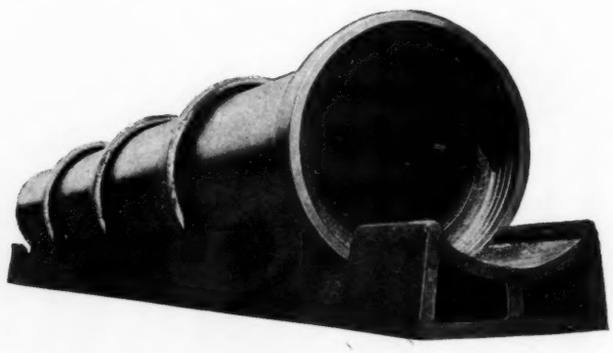
WILLIAMS HEATING TORCH

The "Universal" torch is said to be valuable on nearly every kind of heating work; the manufacturers point out, that its unique construction gives much greater heat. This cuts labor costs, speeds up every job, and is especially important to the contractor on repair work, as it helps to keep machinery going with least possible shut-down.

The unique design of the Williams "Universal" torch concentrates an intense heat on the spot to be worked, and the swivel head of the "Universal" enables the mechanic to direct the full



TYPE W B 220 BUHL COMPRESSOR



RIC-WIL VITRIFIED CRADLE AND DRAIN

THE ONLY DITCHER THAT DIGS STRAIGHT DOWN

THERE is no other ditcher like the Barber-Greene. For, no other ditcher has the vertical digging boom, that cuts service laterals flush with buildings—that comes straight up at walk or curb and goes straight down the other side—that leaves no ramps for shovelers—that cuts through frost, coral rock, shale, and even macadam, at which ordinary ditchers throw up their hands in horror.

And no other ditcher has the Overload Release that automatically protects the ditcher—and the pipes which are met underground.

"Ditching Snapshots and Records" is just what the name says. Have us send you a copy.

NO OTHER DITCHER LIKE THIS BECAUSE—

Barber-Greene Company, 635 West Park Ave., Aurora, Illinois

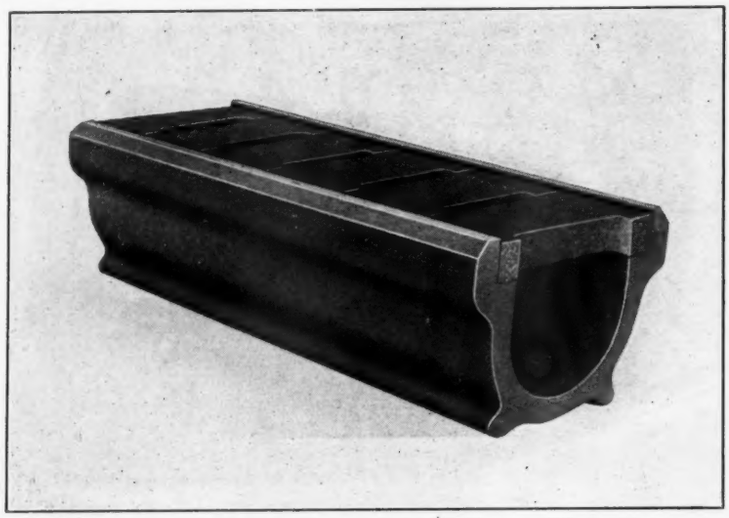
Vertical Boom B STANDARDIZED MATERIAL-HANDLING MACHINES G DITCHER

Four to Seven Feet Maximum Depths
Standard Widths: Eighteen to Twenty-four Inches
Also, Conduit and Curb and Gutter Specials

force of the 14-inch flame on the work from any position. It gives him the advantage of a full 180° working range. No blocking up of the torch, or removal of a part that is hard to get at, is needed for minor repairs requiring heat. Reports show that jobs which have taken mechanics 4 to 5 hours to do with ordinary torches are finished in one hour with this much faster heater. For instance, one case is mentioned where a 4-inch shaft was heated to cherry red in 7½ minutes, and the job fully straightened with perfect satisfaction. Another shows where a 3-inch shaft was heated to cherry red in 2½ minutes, and ¾-inch rivets heated for driving in less than 3½ minutes.

The generator, which is a quarter-inch special alloy bronze pipe coil insures a steady flow of correctly aerated gas to the needle valve. The nozzle itself has three oxygen intakes, insuring correct mixture of gas and air to give the best heating results. The reservoir is heavy seamless steel tubing with the head and base shrunk in, riveted and brazed. The patented swivel head is constructed so that the valve seats accurately at all times, without grinding and with absolutely no chance of leakage. The valve is held firmly in place by a heavy steel spring; it stays put in any working position. All union and connections at the top of the reservoir are of bronze.

The Williams "Universal" hand torch is made in ½-gallon and 1-gallon sizes.



AMCO RAWN UNDERDRAIN
Completely assembled with six piece cover. Slotted apertures provide passages for the free movement of liquid down into the channel and of air up from the channel through the filtering material.

Pioneer Gravel Equipment

The Pioneer Gravel Equipment Mfg. Co., Minneapolis, Minn., has been organized to carry on the manufacture of the Russell line of gravel equipment. The Russell Grader Mfg. Co. was merged into the Caterpillar Tractor Co., which will devote its efforts to building machinery for use with tractors.

Eleven sizes of screening, crushing and loading plants are manufactured, as well as various other equipment in this line. The new Model 12 Pioneer crushing, screening and loading plants, illustrated herewith, is adapted to a variety of conditions.

Amco Rawn Underdrain for Trickling Filters

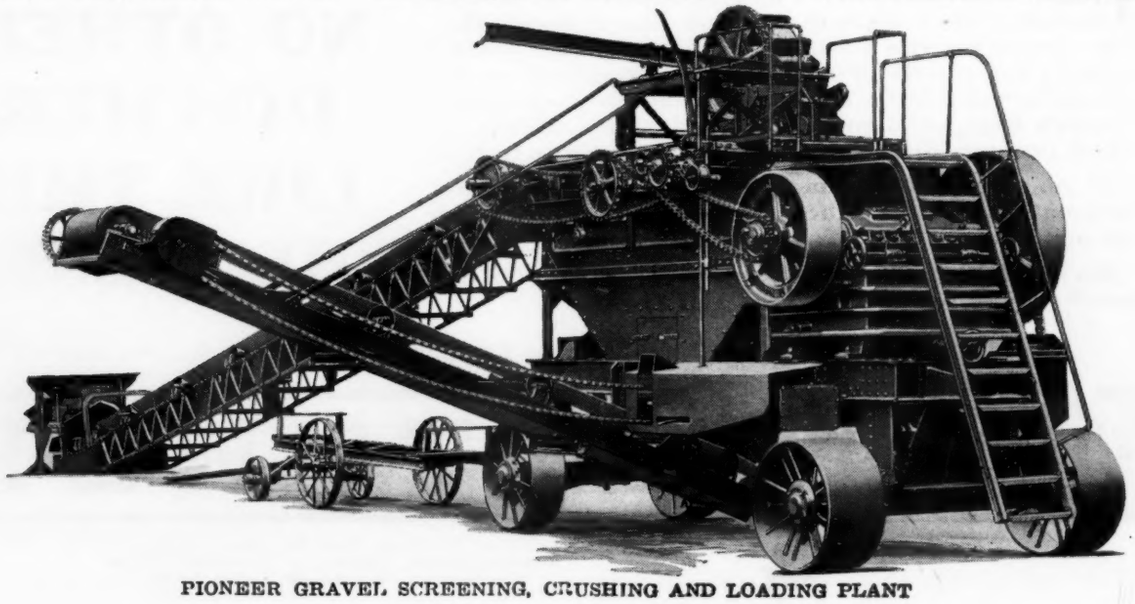
The American Vitrified Products Co., Akron, O., manufactures Amco Rawn underdrains for use in trickling filters. These are of vitrified tile, and are so designed as to make installation simple and easy. They may be laid on concrete, the interchannels being filled with lean concrete; or, where the soil is suitable, they may be laid directly on it, at a considerable saving. The channel sizes are large enough to permit flushing with a fire hose.

Design data include the following: Minimum thickness ⅞ inch; approximate weight 30 pounds per foot including cover blocks. Cross sectional areas: End area, over all, 55 sq. in.; end area inside, 23.14 sq. in.; displacement per lineal foot, .382 cubic foot. Over all area determined to highest point of tile; inside area determined to top of inside shoulders only. Crushing strength approximately 6,000 lbs. lineal foot; no longitudinal joint in the flow line; one transverse joint every two feet; covers laid loose; strength of ware reduces breakage to a minimum during handling; can be nested when piled, requiring small storage space; can be stood on end without support.

Chausse Asphalt Street Repair Unit

The Chausse Oil Burner Company of Elkhart, Ind., has announced an asphalt street repair unit or patching plant for small cities. The new machine, known as Model H-1, is not to be confused with the Chausse Model E-3 engine-equipped self-propelling outfit, although it contains many of the features of the larger unit.

The Model H-1 Chausse unit is built to afford medium size municipalities the



PIONEER GRAVEL SCREENING, CRUSHING AND LOADING PLANT

Iron-to-iron joints

...FREE FROM LEAKAGE

Easier! Quicker! Safer! No lead nor lead substitutes, nor any other jointing materials when you lay Universal Pipe. No pouring, no calking, no bell holes to dig....

Universal Pipe lines are free from leakage because *the machined hub end and the machined spigot end* as well as the pipe itself are *all-cast iron.* Nothing to deteriorate, nothing to blow out, nothing to work loose in these tight, flexible iron-to-iron joints...Laid anywhere in any season, up hill and down, in rock, in sand, in narrow trenches—wet or dry, on bridges and under water. Curves laid with straight lengths. In service the country over for water supply, fire protection, sewage disposal and other service where freedom from leakage is essential.

Such labor-simplicity and unfailing dependability is worthy of your most serious consideration... Our nearest office is at your service

UNIVERSAL CAST IRON PIPE

No bell holes to dig: No joints to calk

THE CENTRAL FOUNDRY COMPANY

Subsidiary of The Universal Pipe and Radiator Company

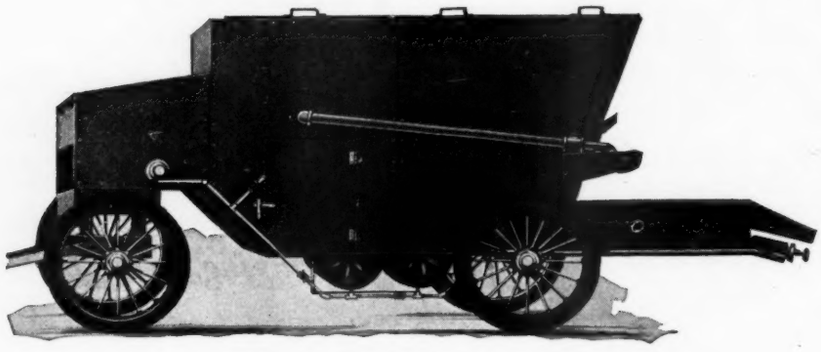
Graybar Building, 420 Lexington Avenue

Chicago Birmingham New York Dallas San Francisco

opportunity to do their own street repair work, independent of large stationary plants which cannot be operated economically on small yardage. It is a hand mixing plant designed for use directly on the street and containing marked improvements over any hand-mixing methods heretofore offered.

The plant is self-contained and is mounted on steel wheels, with roller bearings and 32x5 solid rubber tires. It has a towing tongue for ready attachment to a motor truck or tractor. At the front is a tool heating compartment, lined with fire brick and asbestos, with a steel grizzley on which to place the tools, and equipped with a Chausse oil burner.

In the next section is located a tar kettle with capacity of 150 gallons. This has an oil burner underneath which makes possible initial pouring in from 15 to 20 minutes and will melt the entire capacity in about 45 minutes. The tar is conveyed through a 2-inch pipe to a measuring trough at the rear. Under the tar kettle is a large compartment for tools and accessories, including a



CHAUSSE STREET REPAIR UNIT

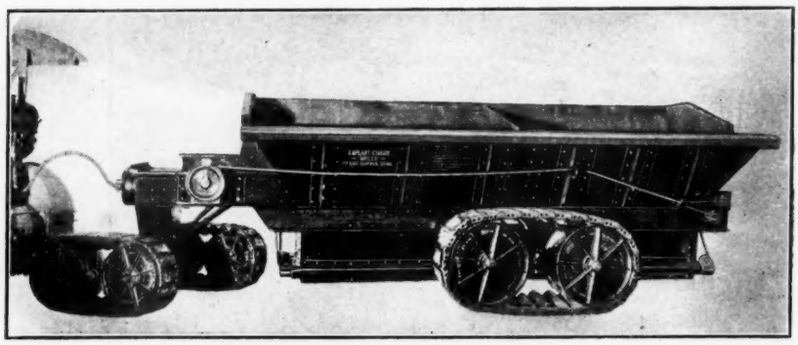
machine type hand pressure pump for putting air pressure on the fuel tanks. In this space can also be kept the 3-gallon hand torch supplied for pre-heating the burners and for warming cold joints, drying patches and other uses.

At the rear of the body of the machine are three storage bins, one for stone and one for sand with capacity of one cubic yard each, and one for stone dust or chips with capacity of ten cubic feet. These bins discharge upon a large drying and mixing pan. Under this pan is a chamber into which point three Chausse burners with ample capacity for quickly drying normally damp aggregate. When the aggregate is dry and heated to proper temperature the asphalt is added from the measuring trough, stirred up by hand and dumped into wheel barrows.

Under the center of the machine are located two steel tanks for kerosene with capacity of about 60 gallons, sufficient for a day's run, with an air pressure gauge. The entire machine is built of steel, hot riveted and welded throughout, with ample structural capacity for the service intended. The axles are alloy steel.

La Plant-Choate "Road-Layer" Dump Wagons

La Plant-Choate Mfg. Co., Inc., Cedar Rapids, Ia., has brought out a crawler wagon designed for the economical handling of dirt in large quantities. The water-level capacity of the J-14 wagon without flare-boards in 8.95 cu. yds.; with flare-boards, it is 11.84 yards; and heaped, the capacity is over 16 yards.



LA PLANT-CHOATE CATERPILLAR CRAWLER WAGON

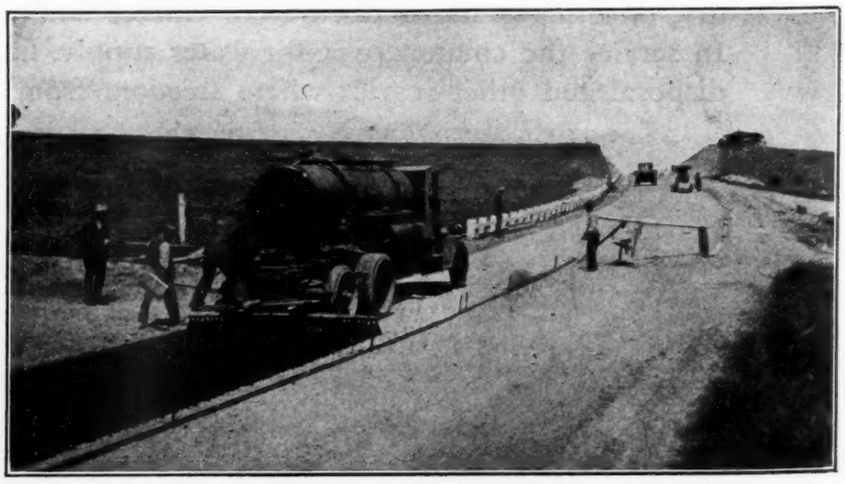
This wagon has several distinct features. In place of front wheels, crawlers are provided, designed to carry about one-fifth of the load. The "Road-Layer" tracks, which are used front and rear are manufactured under license from the Caterpillar Tractor Co. The track surface area is sufficient to reduce the unit load to assure travel even on poor ground.

The wagon dumps at the bottom, leaving a pile of dirt 5 feet wide and 29 inches high. The axles are arched to avoid obstruction by dumped loads. The wagon has a very short turning radius—26 feet in a cut and even less on a fill. The loading height is 68 inches, making it possible to use either a shovel or an elevating grader.

One-man operation is assured through hydraulic devices, making it possible to dump partially or completely by the shift of a lever. Actual practice has shown that a Caterpillar "60" can handle a loaded wagon in high, gear, even in difficult going. Both front and rear tracks follow the path of the tractor tracks. The wagon is equipped with a one-spot greasing system.

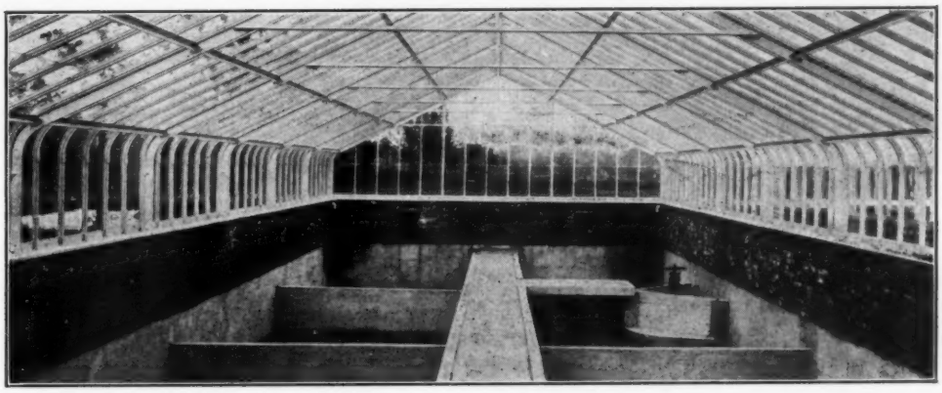
A New Bituminous Emulsion for Road Building

Bitumuls Corporation, San Francisco, Calif., has introduced Bit-u-muls to the American pavement construction field. This is not a new method of road or street construction, but merely a new and convenient form of asphalt. It is a liquid having the color of chocolate, and the consistency of coffee. It is composed of pure bitumen held in suspension in water by a very small



APPLYING BITUMULS ON CALIFORNIA STATE HIGHWAY

Master Construction Glass-Overs for Sludge Beds



Glimpse in Glass-Over at Larchmont, N. Y. Being located in rather a prominent place the structure was made with curved eaves to give a pleasing effect. Frame work is steel. All woodwork is finest grade of "tank" cypress.

There's Over 75 Years Back of Our Expert Service on Sludge Bed Glass-Overs

Seventy-five years ago, we started specializing in Glass Enclosures.

When Sludge Bed Glass-Overs were first thought of, we at once started working them out with the country's leading Sanitary Engineers.

This resulted in our adapting our time-tested Master Construction for Glass-Overs. Now you can have full advantage of all that experience, and know you are getting the last word in Glass-Overs.

Practically every operation in their manufacture is carried on in our own plants, of which we have three.

We even own large tracts of standing cypress, so we can be sure every stick that goes into our Master Construction is the grade best adapted to such exacting conditions.

Glad to send you a list of our various installations, also a description by the engineers of such notable plants as Boonton, N. J., and Marion, Ohio.

Lord & Burnham Co.

SLUDGE BED GLASS-OVERS

Graybar Bldg. New York | Continental Bank Bldg. Chicago | Harbor Com. Bldg. Toronto

Branch Offices: Boston, Philadelphia, Irvington, Albany, Denver, Kansas City, Cleveland, Buffalo, Greensboro, St. Louis, Montreal, St. Catharines

CANT-RUT ROLLER TRUCK

amount of neutral emulsifying agent. It is used cold. It is claimed to remain fluid in storage for many weeks. After application to the roads, it breaks down in a few minutes, forming a uniform black coating.

It is claimed that it can be used in any but actually freezing weather, and that, due to its fluidity, it will penetrate to all parts of the road material, coating all particles. The presence of moisture assists in the adhesion to the stone, and therefore Bitumuls can be used in damp or mildly rainy weather.

New Warco Screw Lift Grader

The W. A. Riddell Company of Bucyrus, Ohio, has brought out the new Warco screw lift grader which was introduced at the road show at Cleveland. This grader utilizes a unique lifting mechanism. Two hand wheels located in the cab which is at the rear of the grader operate the screw through the circle controls. The blade is thus easily raised and lowered. The Warco screw lift is built like a screw jack, a heavy, high carbon screw being employed. It is a positive acting mechanism. There are a minimum of joints to become loose, the mechanism being actuated by a large machine-cut high carbon steel screw turning in a machine-cut bronze nut and gear of one piece construction, having a thread contact equal to sixty inches. The nut and gear are driven by a machine-cut high carbon steel pinion and shaft, forged integral, which is connected by a shaft running to the cab. The gear and pinion are enclosed in a grease tight housing.

Another feature of the grader is the newly designed circle, having large steel casting in the center with rim machined top and bottom, supported between guides at three points on the draw-bar with provisions for take up in case of wear. Extra heavy bars are hot riveted to the circle, and extend far out on either side to support the blade.

Good Roads "Autograder"

The Good Roads Machinery Co., Kennett Square, Pa., has brought out the "Autograder," which, it is stated, represents the latest developments in the design and construction of one-man road graders.

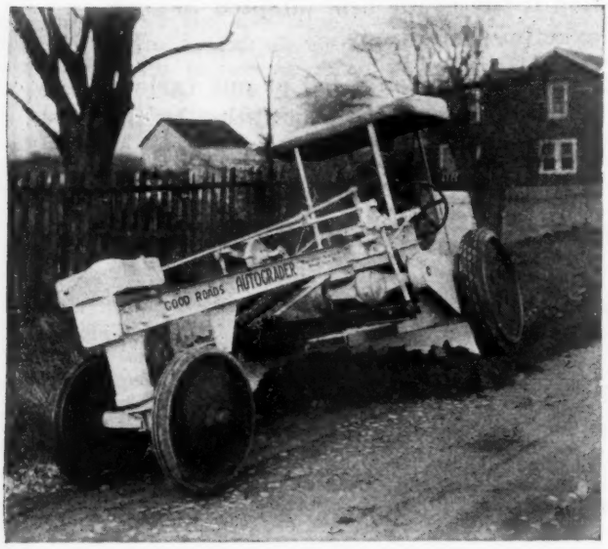
Among the important features claimed for this unit are: A self contained power unit, consisting of a Red Seal Continental gasoline engine, governed at a speed that will insure ample power and long life; power and speed reductions—through automotive type differential and final diamond roller chain drive—giving great working power; ease of operation, low operating and maintenance cost, front end is very heavy, adding strength, and providing special balance to prevent side slipping of front wheels, short wheelbase permits turning in narrow space; blade controls are quick acting and operate with very slight effort, front end is entirely free of steering rods or other parts to become bent or broken, adjustments provided for all wearing parts throughout; disc steel wheels of especially strong construction; steering is quick, positive and extremely asy; equipped with self-starter; remarkable mobility.

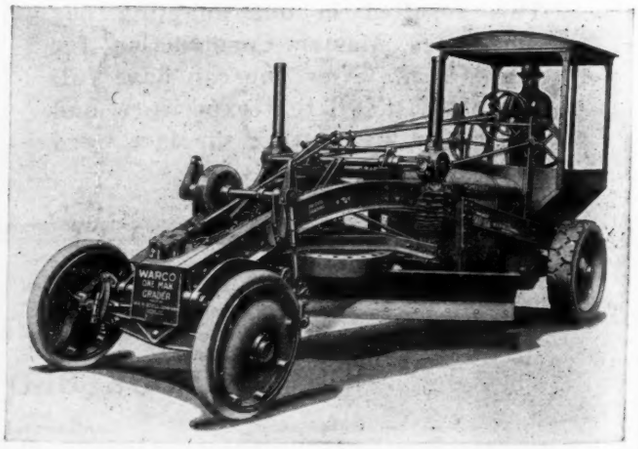
Cleveland Cant-Rut Roller Truck

The Cleveland Crane & Engineering Co., Wickliffe, O., manufactures the Cant-Rut roller truck, which is designed for transporting capacity loads over any surface. The principle is simple. Instead of depending on the bearing surface of two tires on the rear axle the Cant-Rut roller truck has six 12 x 36 tires. This extra bearing surface permits trucks so equipped to travel over ground that would be impassable for ordinary trucks. The truck cannot cut up the road bed. In fact it rolls it smooth. On road work where it is usually necessary to provide a path alongside for hauling, the Cant-Rut roller truck will run over the sub-grade without damage.

The rear axles look heavy, but the weight of each three-tired wheel is claimed to be only about equal to the weight of an ordinary cast steel wheel. This is because rolled steel is used in place of cast steel.

Tire expense is less, since there is three times as much bearing surface as on an ordinary truck the wear is much less. Tire engineers state that the truck will not wear out its original set of tires.





ABOVE: WARCO SCREW LIFT GRADER
AT LEFT: GOOD ROADS "AUTOGRADER"

THE AMERICAN SUMP PUMP

THE "American" Type MMD Sump Pump differs from other motor-driven sump pumps in that it employs a hollow shaft motor in place of the old time solid shaft motor.

With this construction a simpler and more compact machine is possible. Flexible coupling and thrust bearing on the pump are eliminated. The pump shaft extends up through the motor shaft and both motor and pump use the same thrust bearing, mounted in the upper end of the motor, making end adjustment a very simple matter.

No high motor supports are used, the pump supporting pipe bolting direct to a cast iron plate that in turn bolts to the motor. Distortion of the pit cover will not affect the alignment of the pump and motor.

Pump shaft bearings consist of removable bushings. Pit plate is made of plate steel and can be obtained round or square.

Pumps may be furnished for any required settings up to 17 feet in either single or double column.

All units are furnished complete with automatic controlled switch, oiling device and [illegible].

Self-controlled, highly efficient, sturdy in build, they should be considered for your present needs. Complete specifications and catalogs available from our engineering department.

THE AMERICAN WELL WORKS

General Offices AURORA, ILLINOIS and Factory

Branch Offices

Chicago, Ill.
1615 First Nat. Bank Bldg.

New York, N. Y.
Room 523—165 Broadway

Los Angeles, Calif.
420 East Third Street

District Sales Agencies:

Boston, Mass.
Detroit, Mich.
Dallas, Tex.
Omaha, Neb.
Atlanta, Ga.
Charlotte, N. C.
Pittsburgh, Pa.
Roswell, N. M.
Philadelphia, Pa.
St. Louis, Mo.
Tulsa, Okla.
Denver, Colo.
Birmingham, Ala.
Joplin, Mo.
El Paso, Texas
Kansas City, Mo.
St. Paul, Minn.
Portales, N. Mex.
Salt Lake City, Utah
San Francisco, Calif.
Vancouver, B. C., Can.

Hug Redi-Mix Body for Handling Concrete

The Hug Co., Highland, Ill., has brought out a special truck body to handle wet concrete. The outstanding feature of this body is that, in addition to releasing instantly the entire batch of wet material, it actually remixes the concrete in the process of dumping.

The remixing feature is accomplished by providing a baffle cross division plate near the center of the body. Due to the bottom dump feature the wet concrete leaves the body as the body begins to raise, the wet concrete sliding out under the baffle cross member and forcing the top water and cement down through the concrete while dumping, thereby remixing the entire load in the process of dumping, and preventing the top of the load from slushing off.

HUG REDI-MIX CONCRETE BODY

The Hug Redi-Mix body dumps from the rear through a bottom dump feature, this being made possible by a special toggle-arm arrangement, whereby the upper part of the body shell leaves the lower portion of the body, the latter forming a chute for the release of the wet concrete as the body is raised. The construction is such that a partial load may be dumped. This feature permits the delivery of partial loads as required, with one trip to the desired locations.

Asphalt Plank Bridge Flooring

The Universal Asphalt Plank Co., Chicago, Ill., manufactures preformed asphalt saturated felt planks as a wearing surface on bridges. These planks are made of highly compressed felt thoroughly saturated with asphalt and in which there is present fine mineral matter. They are compressed while hot, resulting in a finished product which is very compact.

They possess toughness and resiliency independent of the physical properties of the contained asphalt; they are tough even in the coldest weather. This feature commands their consideration on all bridges and structures where vibrations and impacts are present. The degress of toughness is a factor of the asphalt saturated felt, and the maximum is attained where the felt is present to the extent of about 25 per cent by weight of felt and about 38 per cent asphalt.

The asphalt planks weigh about eight pounds per board foot. Their weight 1½ inches thick, therefore, is less than creosoted wood blocks 3¼ inches thick. The planks are not slippery when wet, because they contain fibre which has a natural braking tendency under friction. They are quickly and economically laid, under any climatic conditions and they develop a permanent waterproofing blanket which is a protection to the structure beneath. They are impervious to water. They are resilient at all temperatures and thus absorb shock and differential movements in the structure. By absorbing vibration they naturally decrease noise. They will not shatter or crack. While not exactly self healing, under moving loads they become sealed and watertight.

The life of the wearing surface may be greatly prolonged, it is claimed, by applying a mop or spray coat of Universal-Krodeproof asphalt followed by a dusting of sand. This maintenance treatment should not be necessary until the asphalt plank has seen two years or more of service. If this is repeated as the wearing surface requires it, the planking surface will become thicker and the flooring should last fifteen years or more.

On wood deck bridges the asphalt planks are secured in place by nailing them to the deck. On concrete deck bridges they are secured by the use of either Universal Krodeproof or hot Universal-Karnak waterproofing asphalt. By imbedding the planks in either of these, the essential permanent bond to the concrete is developed.

The first highway grade crossing involving the commercial use of preformed asphalt planks was designed by Theo. H. M. Crampton, collaborating with A. V. Brown, formerly chief engineer of the Lake Shore Electric Rwy. Mr. Crompton, who is now vice-president of the Universal Asphalt Plank Co., prepared the above statement regarding asphalt planks.

Shawnee Cletrac Power Grader

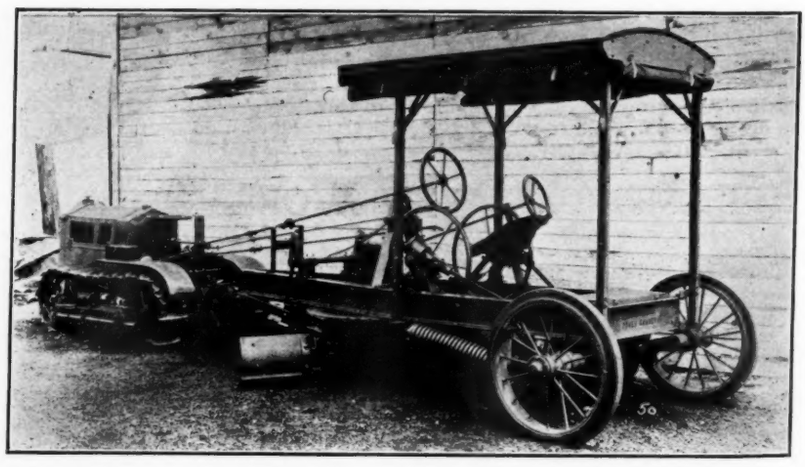
The Shaw-Enochs Tractor Co., Stillwater, Minn., manufactures road and power graders, including the Shawnee Cletrac-powered grader. This is constructed to permit the operation of the tractor without undue strain, and results in unusual accuracy and smoothness of grading. This unit is fully one-man operated and controlled.

The weight complete with tractor, cab and scarifier is 9,425 pounds. Blades ⅝-inch by 12 feet, of special carbon steel are regular equipment, but shorter or longer blades can be furnished. The scarifier is independently operated. An important feature is the ability to detach the tractor in 20 minues without special tools, thus making it available for other work.

Ames Six-Cylinder Road Roller

The Ames Iron Works, Oswego, N. Y., manufacture what is claimed to be the first 6-cylinder road roller. This ten-ton roller is powered with a 60 h.p. Hercules motor, and has a 3-speed transmission forward and reverse, with speeds of either 1½, 3 and 4½ or 1, 2 and 3 miles per hour. A single lever gives control for forward and reverse motion.

This roller possesses a number of important features making for easy and economical operation. All moving or wearing parts are entirely enclosed from dust or dirt, yet are accessible. The front roll pivots on the center line of the axle, so that extremely uneven road surfaces cause no



SHAWNEE CLETRAC POWER GRADER

CAST Q IRON

TRADE MARK

THIS "Q-check" mark designates Cast Iron Pipe made in accordance with established technical specifications. The Cast Iron Pipe Research Association has adopted this mark for use by its members.

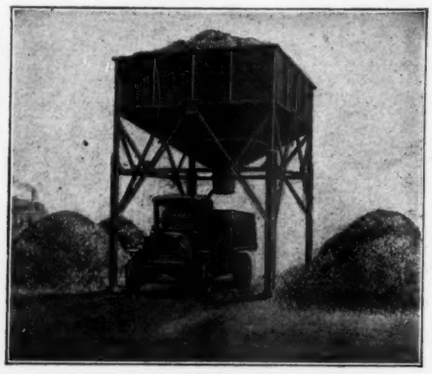
All pipe, both deLavaud centrifugal and vertically sand cast, made by the United States Cast Iron Pipe and Foundry Company will hereafter bear this symbol. A representative pipe shipment marked with the "Q-check" symbol is shown in the photograph reproduced above, which was taken at the yards of this Company at Burlington, New Jersey.

United States Cast Iron Pipe and Foundry Co., Burlington, New Jersey

Sales Offices: Chicago, Philadelphia, Buffalo, Cleveland, New York, San Francisco, Los Angeles, Seattle, Birmingham, Dallas, Kansas City, Pittsburgh, Minneapolis

No. 127 Trade Papers Mch

swaying of the front end of the roller, making steering easy and positive. This pivoting feature also prevents setting the roll on edge when making short turns. A built-in differential



BEAUMONT COPPERSTEEL BIN

materially aids in this respect, as it permits freedom of side movement of front end of roller. The inside turning radius clearance is 11 feet, the outside clearance 19 feet 6 inches.

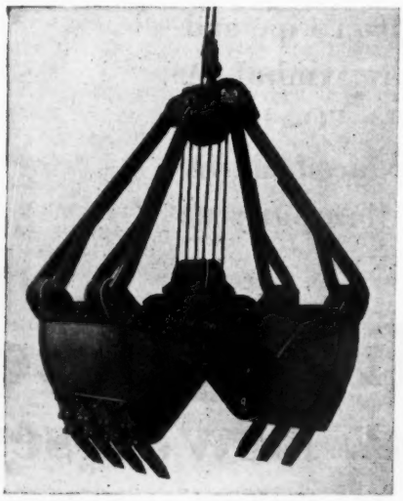
The scarifier consists of a clutch-operated air compressor with air tank. Two air cylinders are mounted vertically directly over the scarifier bar. The angle at which the teeth are set, together with the long drawbar employed, makes a scarifier requiring less pressure to hold down than any similar device. It is direct acting, and the air tank is located under the hood. The scarifier is the full width of the roller. It is easily lowered or raised by means of the four-way air valve conveniently located to the position of the operator.

The wheel base is 120 inches; length over all, including scarifier, 209 inches; over all width 78 inches; height 70 inches.

Two Improved Types of Owen Clamshell Buckets

The Owen Bucket Company of Cleveland, Ohio, is introducing two improved types—one an exceptionally capacious rehandling bucket—the type "S," and the other a heavy duty digging bucket—the type "D."

The type "S" Rehandling Bucket has been designed for maximum output when rehandling loose or compact materials.



OWEN TYPE D BUCKET

It is constructed on liberal lines, and due to its exceptional width and length when opened, it is particularly efficient for cleaning up materials loaded to shallow depths over large areas. It is recommended for unloading barges, flats, cars and for stock pile work.

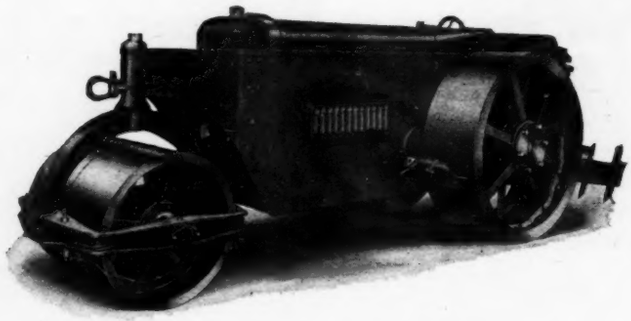
The type "S" Bucket is made in standard, heavy and special models to suit requirements. Some of the important features include: One-piece steel crosshead; concentration of weight located on the centershaft which affords greater digging power; sealed centershaft bearings, keeping the grease in and the grit out, an advantage essential to low upkeep and operating costs; rigid shell construction with minimum number of parts; proper reinforcement and long life sheaves and cables due to exclusive method of mounting on the main counterweight.

The Owen type "D" heavy duty buckets are designed for extra heavy digging and handling or for any work that subjects the bucket to excesive and severe strain. They are of exceptionally strong construction throughout. Some of the exclusive features incorporated in type "D" Buckets are one-piece extra heavy renewable jaws, grit-proof lubricated bearings, concentration of weight low in the construction for greater digging power, and the Owen method of stopping the jaws at a fixed open position to absorb dropping shocks.

The type "D" Buckets are made in standard, extra heavy and narrow models to suit every difficult digging problem. They are particularly efficient and durable for work in stiff clay, ore, broken rock, slag or shale, dredging coarse gravel or other materials that demand a bucket of unusual strength and wear-resistant qualities.

Beaumont Coppersteel Material Bins

Beaumont Mfg. Co., Philadelphia, Pa., manufactures material bins constructed entirely of copper steel plate which will last, it is claimed, two or three times as long as ordinary bins. These bins are all bolted construction, and structurally rigid. They are built in sizes ranging from 15 to 110 cubic yards. They have a full gravity discharge, preventing clogging. The bins are easily erected, easily portable, and may be shipped in a few parts, all match-marked and accurate as to hole spacing.



AMES 6-CYLINDER 10-TON ROLLER

The Beaumont "Addabin," which is built only in the larger sizes, saves considerable yard space as any number of bins can be placed in a row and added to at considerably less expense than if a new single bin is added. The columns of the "Addabin" are designed so that an additional bin can be placed alongside the existing bin by simply adding the bin unit and one set of columns, all columns being designed with sufficient strength to take care of this condition.

TRADE PUBLICATIONS

The Thew Handbook—The Thew Shovel Co., Lorain, O., has issued a handbook on the operation, care, adjustment and application of power shovels and excavating machines. This is published in loose-leaf form so that it can be kept up to date by future additions. It is divided into three sections, the first covering all operations of Lorain machines, the second covering the care and adjustment of Lorain machines, and the third covering general excavating information, data and tables pertaining to excavating work.

OWEN TYPE S BUCKET

Over the Top with Trackson Power

TRACKSON TRACTOR EQUIPMENT

IT'S always victory—no matter what the odds—with the Trackson Full-Crawler. It battles time, costs and obstacles with eager, inexhaustible, sure-footed power. Down into excavations, working like a Trojan in close quarters, taking the hard pulls and steep slopes like a mountain burro . . . gripping fast in the worst places. ¶ Filling trenches, leveling city dumps with the powerful Bulldozer attached. ¶ Scooping out huge mouthfuls where an empty truck doesn't dare go, doubling the number of trips, speeding up the job with Trackson Shovels and Loaders. ¶ Rain or shine, over smooth stretches and rough—hauling, ditching, scarifying, crowning, grading, miles without end . . . ¶ Always *over the top* to greater profits and quicker, better jobs with Trackson Equipment . . . Let us tell you how to put it to work for you. Write for complete description of equipment and uses. No obligation, of course.

Trackson Company
FULL-CRAWLERS & TRACTOR EQUIPMENT
503 CLINTON ST. MILWAUKEE, WIS.

Trackson
FULL-CRAWLERS
BULLDOZERS
LOADERS
SHOVELS
CRANES
for the McCORMICK-DEERING TRACTOR

Itemized Costs of Construction

Highway Improvement and Bridges

Grafton, N. H.

Bids received by New Hampshire Highway Department, Dec 7, 1928. 23 bidders:

A—Lane Const. Corp., 35 Colony St., Meriden, Conn. B—Hagen-Thibodeau Co., 45 Waterman Ave., Eden Park, R. I. C—B. Perini & Sons Co., Ashland, Mass. D—State Construction Co., 42 Prospect St., Somerville, Mass.

Items.	A Unit price	B Unit price	C Unit price	D Unit price
16,640 cu. yds. earth excavation	$0.60	$0.70	$0.70	$0.70
956 cu. yds. borrow	.25	.70	.70	.70
1,267 cu. yds. ledge excavation	2.50	2.00	2.75	3.50
345 cu. yds. structural excavation	4.00	3.00	3.00	3.00
3,374 cu. yds. gravel base course	1.00	1.00	1.00	1.00
2,460 cu. yds. gravel surface course	1.25	1.25	1.30	1.50
132 cu. yds. Class B concrete	25.00	20.00	25.00	30.00
218 cu. yds. Class C concrete	18.00	20.00	20.00	18.00
12,896 lbs. reinforcing steel	.065	.05	.07	.06
200 lin. ft. laying 15" c. i. pipe	1.25	1.00	1.10	1.25
75 lin. ft. laying 24" c. i. pipe	2.25	1.00	1.25	2.00
150 lin. ft. wood guard railing	0.60	.75	.60	.70
3,485 lin. ft. wire cable rail WP	0.65	.75	.65	.70
128 lin. ft. wood railing for bridge	1.00	1.00	1.50	3.00
- temporary bridge each	100.00	200.00	300.00	150.00
2.7 acres clearing and grubing	175.00	100.00	100.00	100.00
Total	$33,116.24	$33,939.25	$35,762.17	$38,177.06

Pavement

Newton, Kansas.

3,505 sq. yds. concrete paving, sand-gravel mix pit run; cost per sq. yd. $1.85
657 cu. yds. grading at average depth of 6 ins. in clay soil; cost per cu. yd. ..... .50
Curb and gutter integral with paving.
Cost of day labor, per day 3.20
Cost of sand delivered, per yard 1.40
Cost of cement delivered, per 100 lbs. 240
Contractor: L. Phares, Newton, Kansas.

7,550 sq. yds. 2½-in. brick paving, cost per sq. yd. $1.75
16,010 sq. yds. 3-in. brick paving, cost per sq. yd. 1.85
Brief of specifications: Loss by abrasion not over 24%; brick to be laid on 1-in. sand cushion; all resurfacing, original surface asphalt pavement.
Cost of day labor, per day 3.20
Cost of cushion sand delivered, per ton .. 1.20
Cost of cement delivered, per 100 lbs. 240
Total contract price: $41,866.
Contractor: Staton & Wallace.
Information from "Kansas Municipalities."

Sidewalk

Marysville, Kansas.

75,000 sq. ft. 4" cement sidewalk; ½" wearing surface; 1 part cement, 2 parts sand. Cost per sq. ft. $0.14

The book has been designed specifically for the owner, engineer or estimator and contains considerable information for which he would have to look to several sources, were it not for this handbook. The book is printed on heavy durable bond paper and is bound in a flexible imitation leather cover. It is being distributed by The Thew Shovel Co., Lorain, O., at a nominal cost to interested parties.

INDUSTRIAL NOTES

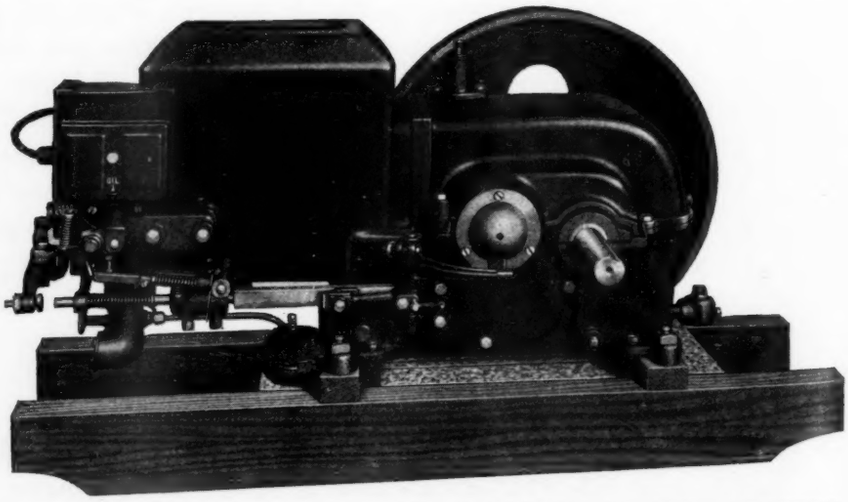
Bay City Dredge Works, Bay City, Mich., has changed its name to Bay City Shovels, Inc. The change is in name only, to indicate more clearly the present principal type of product. There is no change in policy, ownership or personnel.

G. D. Simonds, formerly with the Graybar Electric Company is now Sales Engineer for the Four Wheel Drive Auto Co., Clintonville, Wisconsin, manufacturers of FWD trucks. Mr. Simonds will be located in New York City and will devote his attention to the development and sale of FWD public utility trucks, winches, derricks, trailers, etc.

The T. L. Smith Company of Milwaukee announces the purchase of the Kwik-Mix Concrete Mixer Company, Port Washington, Wisconsin. The entire plant of the company at Port Washington will continue to be operated as heretofore with the exception of the business office, which will be combined with the T. L. Smith Company Milwaukee office. With the acquisition of the various Kwik-Mix models, the T. L. Smith Company now has a most complete line of mixers, ranging from the 2½-S size to the 112-S tilter, the world's largest mixer. The T. L. Smith Company is one of the independent divisions of the National Equipment Corporation.

The Trackson Company, Milwaukee, Wis., announces that arrangements have been completed with the Thorman W. Rosholt Company, 928 S. Fourth Street, Minneapolis, Minn., for the distribution of Trackson Tractor Equipment for the McCormick-Deering Industrial Tractor. The new distributors will handle the territories which are covered by the following branches of the International Harvester Company: Fargo and Grand Forks, N. D.; Winona, St. Cloud, Minneapolis, and Mankato, Minn., and Eau Claire, Wis. The Rosholt Company will carry stocks of Trackson Full-Crawlers, Loaders, Shovels, Cranes, Bulldozers, etc. and will be able to make prompt deliveries on these machines as well as on repair and replacement parts.

Purchase of the entire common capital stock of the Galion Iron Works & Manufacturing Co., of Galion, Ohio, by the Jeffrey Manufacturing Co., Columbus, Ohio, was recently announced. The Galion Iron Works & Manufacturing Co. is one of the old established manufacturers of road machinery, including a full range of gasoline and steam road rollers, leaning wheel road graders, tractor power graders, road drags, road plows, cast-iron and special non-corrosive galvanized culverts and miscellaneous equipment for road work. In addition to road machinery the Galion plant has developed elevating and conveying equipment for handling coal, stone, gravel and other materials into central storage plants. The units of material-handling equipment which can be more economically produced at the Jeffrey plant at Columbus will add to the Jeffrey output and, at the same time, give additional capacity at Galion for specialized road machinery. The new officers of the company are: D. C. Boyd, Chairman of the Board; Robert W. Gillispie, Pres. and Gen'l Mgr.; J. S. Boyd, Vice-Pres.; F. W. Faber, Secy. and Treas. Mr. Gillispie is also Vice-Pres. and Gen'l Mgr. of the Jeffrey Manufacturing Company.



COMPLETELY ENCLOSED, SPLASH OILED HORIZONTAL ENGINE RECENTLY BROUGHT OUT BY STOVER ENGINE CO., FREEPORT, ILL.